genious COCKER! (Now to Rest thou'rt Gone)
oe Art can Show thee fully but thine own
Thy rare Arithmetick alone can show
Th' vast Sums of Thanks wee for thy Labours owe.

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Cocker's
ARITHMETICK:

BEING

A plain and familiar Method, ſuitable to the meaneſt Capacity, for the full underſtanding of that incomparable Art, as it is now taught by the ableſt School-Maſters in City and Country.

COMPOSED

By *Edward Cocker*, late Practicioner in the Arts of Writing, Arithmetick, and Engraving. Being that ſo long ſince promiſed to the World.

PERUSED and PUBLISHED

By *John Hawkins*, Writing-Maſter near St. *George's* Church in *Southwark*, by the Author's correct Copy, and commended to the World by many eminent Mathematicians and Writing-Maſters in and near *London*.

This Impreſſion is corrected and amended, with many Additions throughout the whole.

Licenſed, *Sept.* 3. 1677. *Roger L'Eſtrange.*

LONDON,

Printed by *R. Holt*, for *T. Paſſinger*, and ſold by *John Back*, at the black Boy on *London-Bridge*, 1688.

TO his much honoured Friends *Manwaring Davies*, of the *Inner Temple*, Esquire; and Mr. *Humphrey Davies* of St. *Mary Newington* Buts, in the County of *Surrey*,

John Hawkins, As an Acknowledgment of unmerited Favours, humbly Dedicateth this *Manual of Arithmetick*.

To the READER.

Courteous Reader,

I Having the Happiness of an Intimate Acquaintance with Mr. *Cocker* in his Life time often sollicited him to remember his Promise to the World, of Publishing his Arithmetick, but (for Reasons best known to himself) he refused it; and (after his Death) the Copy falling accidentally into my hands, I thought it not convenient to smother a work of so considerable a moment, not questioning but it might be as kindly accepted, as if it had been presented by his own hand. The Method is familiar and easie, discovering as well the Theorick as the Practick of that Necessary *Art* of Vulgar *Arithmetick*; And in this new Edition there are many remarkable Alterations for the benefit of the Teacher or Learner, which I hope will be very acceptable to the World: I have also performed my Promise in Publishing the Decimal Arithmetick, which finds encouragement to my Expectation, and the Booksellers too. I am

Thine to serve thee,

John Hawkins.

Mr.

Mr. *Edward Cocker's*

PROEME or PREFACE.

BY the *ſacred Influence of Divine Providence, I have been inſtrumental to the benefit of many, by virtue of thoſe uſeful Arts*, Writing *and* Engraving: *And do now with the ſame wonted alacrity caſt this my Arithmetical Mite into the Publick Treaſury; beſeeching the Almighty to grant the like bleſſing to theſe as to my former Labours.*

Seven Sciences *ſupremely excellent,*
Are the chief Stars in Wiſdom's Firmament:
Whereof Arithmetick *is one, whoſe worth*
The Beams of Profit and Delight ſhines forth;
This crowns the reſt; this makes man's mind complete;
This treats of Numbers, and of this we treat.

I have been often deſired by my intimate Friends to publiſh ſomething on this Subject; who in a pleaſing Freedom have ſignified to me that they expected it would be extraordinary. How far I have anſwered their Expectations, I know not; but this I know, that I have deſigned this Work not extraordinary abſtruſe or

profound, but have by all means possible within the Circumference of my Capacity, endeavoured to render it extraordinary useful to all those, whose Occasions shall induce them to make use of Numbers. If it be objected that the Books already published, treating of Numbers, are innumerable, I answer that's but a small wonder, since the Art is infinite. But that there should be so many excellent Tracts of Practical Arithmetick extant, and so little practised, is to me a greater wonder; knowing that as Merchandise is the Life of the Weal-Publick; so Practical Arithmetick is the Soul of Merchandise. Therefore I do ingeniously profess, that in the beginning of this undertaking, the numerous Concerns of the honoured Merchants first possessed my Consideration: and how far I have accommodated this Composure for his most worthy Service, let his own profitable experience be judge.

Secondly, For your Service, most excellent Professors, whose understandings soar to the sublimity of the Theory and Practice of this noble Science, was this Arithmetical Tractate composed; which you may please to employ as a Monitor to instruct your young Tyroes, *and thereby take occasion to reserve your precious moments, which might be exhausted that way, for your more important Affairs.*

Thirdly,

Thirdly, For you, the ingenious Off-ſpring of happy Parents, who will willingly pay the full Price of Induſtry and Exerciſe for thoſe Arts and choice Accompliſhments which may contribute to the Felicity of your future State. For you, I ſay, (ingenious Practicioners) was this Work compoſed, which may prove the Pleaſure of your Youth, and the Glory of your Age.

Laſtly, For you the pretended Numeriſts of this vapouring Age, who are more diſingeniouſly witty to propound unneceſſary Queſtions, than ingeniouſly judicious to reſolve ſuch as are neceſſary. For you was this Book compoſed and publiſhed, if you will deny your ſelves ſo much as to invert the ſtreams of your ingenuity, and by ſtudiouſly conferring with the Notes, Names, Orders, Progreſs, Species, Properties, Proprieties, Proportions, Powers, Affections and Applications of Numbers delivered herein, become ſuch Artiſts indeed, as you now only ſeem to be. This Arithmetick ingeniouſly obſerved, and diligently practiſed, will turn to good account to all that ſhall be concerned in Accompts. All whoſe Rules are grounded on Verity and delivered with Sincerity. The Examples are built up gradually from the ſmalleſt conſideration to the greateſt. All the Problems or Propoſitions are well weighed, pertinent and clear, and not one of

them

them throughout the Tract taken upon trust therefore now,

Zoilus and *Momus* lie you down and dy,
For theſe Inventions your whole force defy.

Edward Cocker.

Courteous Reader,

Being well acquainted with the deceased Author, and finding him knowing and studious in the Mysteries of Numbers and Algebra, of which he had some choice Manuscripts, and a great Collection of Printed Authors in several Languages. I doubt not but he hath writ his Arithmetick suitable to his own Preface, and worthy acceptation, which I thought to certifie on a request to that purpose made to him that wisheth thy Welfare, and the Progress of Arts.

John Collens.

Novemb. 27th. 1677.

This Manual of Arithmetick is recommended to the World by Us whose Names are subscribed, viz.

Mr. *John Collens*, Mr. *James Atkinson*, Mr. *Peter Perkins* — Math.	Mr. *William Mason*
Mr. *Rich. Laurence* Senior	Mr. *Steph. Thomas*
Mr. *Eleazer Wigan*	Mr. *Peter Storey*
Mr. *Rich. Noble* of *Guilford.*	Mr. *Benj. Tichbourn*
Mr. *William* Norgate	Mr. *Joseph Symmonds*
	Mr. *Jerem. Milles*
	Mr. *Josiah Cuffley*
	Mr. *John Hawkins*

And generally approved by all ingenious Artists.

A Table

A Table of the Contents of this BOOK.

CHAP.

CHAP. I.

Notation of Numbers.

1. ARITHMETICK is an Art of Numbring or Knowledge, which teacheth to number well, (*viz.*) the Doctrine of Accompting by Numbers. And there are divers ſpecies and kinds of Arithmetick and Geometry, the which we do intend to treat of in order; applying the Principles of the one to the Definitions of the other: For as Magnitude or Greatneſs is the ſubject of Geometry, ſo Multitude or number is the ſubject of Arithmetick; and if ſo, then their firſt Principles and chief Fundamentals, muſt have like Definitions; or at leaſt, a Semblable Congruency.

2. Number, is that by which the Quantity of any thing is Expreſſed or Numbred; as the Unit is the number by which the quantity of one thing is expreſſed or ſaid to be

one, and two by which it is named two, and $\frac{1}{2}$ half by which it is named or called half, and the Root of 3 by which it is called the Root of 3, the like of any other.

3. Hence it is that Unit is Number, for the part is of the ſame matter that is his whole, the Unit is part of the Multitude of Units, therefore the Unit is of the ſame matter that is the Multitude of Units; but the matter of the Multitude of Units is number, therefore the matter of Unit is number: for elſe if from a number given, no number be ſubſtracted, the number given remaineth; let three be the number given, from which number ſubſtract or take away one (which as ſome conceive is no number) therefore the number given remaineth, that is to ſay, there remaineth three, which is abſurd.

4. Hence it will be convenient to examine from whence Number hath its Riſe or Beginning: Moſt Authors maintain that Unit is the beginning of Number, and it ſelf no number; but looking upon the Principles and Definitions in the firſt rudiments of Geometry, we ſhall find, that the definition of a Point is in no way congruous with the Definition of an Unit in Arithmetick; and therefore one, or Unit muſt be in the Bounds or limits of Number, and conſequently

ſequently the beginning of Number is not to be found in the number one; wherefore to make number and magnitude congruent in Principles, and like in Definitions, we make and conſtitute a Cypher to be the beginning of number, or rather the medium between increaſing and decreaſing numbers, commonly called abſolute or whole numbers, and negative or fractional numbers, between which nothing can be imagined more agreeable to the definition of a point in Geometry; for as a Point is an adjunct of a line, and it ſelf no line, ſo is (o) Cypher an adjunct of number and it ſelf no number: And as a Point in Geometry cannot be divided or increaſed into parts, ſo likewiſe (o) cannot be divided or increaſed into parts; for as many points though in number infinite do make no line, ſo many (o) Cyphers, though in number infinite do make no number. For the line A B cannot be increaſed by the addition of the point C, neither can the number D be increaſed by the addition of the (o) Cypher E, for if you add nothing to 6, the Sum will be 6, (o) neither increaſing nor diminiſhing the number 6, but if it be granted that A B be extended or prolonged to the Point C, ſo that A C be made

A——B

C

D 6

E o

ſum 6

A---B---C

D E
6 o } 60

a continued line, then AB is increased by the addition of the point C, in like manner if we grant D 6 be prolonged to E (0) so that D E (60) be a continued number making 60, then 6 is augmented by the Aid of (0) as to the constituting the number (60) sixty; And furthermore that one or unit is material and a number, and that (0) is the beginning of Number is proved by all Authors although indirectly, for the Tables of Sines and Tangents prove one degree to be a number, because the Sine of 1 degree is 174524 (the Radius being 10000000) and the beginning of that Table is (0) and to it answereth 00000, *&c.*

5. Hence it is that number is not quantity discontinued, for all that which is but one quantity, is not quantity disjunct; (60) sixty as it is a number, is one quantity, *viz.* one number (60) sixty; therefore as it is number, it is not quantity disjunct; for number is some such thing in Magnitude, as humidity in water; for as humidity extends it self through all and every part of Water, so number related to magnitude, doth extend it self through all and every part of magnitude. Also as to continued Water doth answer continued Humidity, so to a continued Magnitude doth answer a continued Number. As the continued Humidity of any

any intire Water, suffereth the same Division and Distinction that his Water doth; so the continued Number suffereth the same Division and Distinction that his Magnitude doth. From all which Considerations we might enlarge a farther Digression concerning Number and Magnitude, by comparing the Definitions of the one with the Principles of the other, for having found a (o) Cypher to be answerable in Definition to a point in Magnitude, we may very well conclude that number may be congruent to a line; as also the Figurative Number to be consonant in Definition with a Superficies, and Solid, *&c.* in the order of Geometrical Magnitudes.

6. The Characters or Notes by which Numbers are signified, or by which a Number is ordinarily expressed, are these following, (*viz.*) o Cypher or nothing, 1 One, 2 Two, 3 Three, 4 Four, 5 Five, 6 Six, 7 Seven, 8 Eight, 9 Nine: The Cypher, which though of it self signifieth nothing (*viz.*) expresseth not any certain or known quantity, but is the Beginning, Radix or Root of Number, and the other nine Figures or Characters are called significant Figures or Digits.

7. In Numbers of any sort, two things

are to be considered, (*viz.*) Notation and Numeration.

8. Notation teacheth how to describe any Number by certain Notes and Characters, and to declare the value thereof being so described, and that is by Degrees and Periods.

9. A degree consists of three figures, *viz.* of three places comprehending Units, Tens and Hundreds, so 365 is a degree, and the first figure (5) on the right hand, stands simply for its own value, being Units or so many ones (*viz.*) five; the second in order from the right, signifies as many times ten, as there are unites contained in it, (*viz.*) sixty; the third in the same order signifies so many hundreds as it contains Units, so will the expression of the Number be, three hundred sixty five; also 789, is seven hundred eighty nine, &c.

10. A Period is when a Number consists of more than three figures, or places, and whose proper order is to prick or distinguish every third Place beginning at the right hand, and so on to the left; so the Number 63452 being given, it will be distinguished thus, 63.452, and expressed thus, sixty three thousand four hundred fifty two; likewise 4.578.236.782, being distinguished, as you see will be expessed thus, four thousand

thousand five hund seventy eight millions, two hundred thirty six thousand, seven hundred eighty two.

11, Number is either absolute or Negative.

12. An Absolute, or intire, whole, Increasing Number, is that which by annexing of another Figure or Cypher it becomes ten times as much as it stood for before; and if two Figures or Cyphers be annexed, it makes it a hundred times more than it stood for before, *&c.* as if you annex to the Figure 6 a Cypher, then it will become (60) sixty: so if two Cyphers be annexed, then it will be (600) six hundred; and if you do annex to it a (4) four, then it will be (64) sixty four; and if you annex (78) seventy eight, it will be then (678) six hundred seventy eight, and so on: By annexing more Figures or Cyphers, it will encrease in a decuple proportion *ad Infinitum.*

13. A Negative, or Broken, Fractional, Decreasing Number, is that which by prefixing a Point or Prick towards the left hand its value is decreased from so many Units, to so many tenth parts of any thing; and if a point and (0) cypher, or a digit be prefixed, it will be then so many hundred parts, and if a Point, and two Cyphers or digits be prefixed, its Value is decreased to be so

many thouſandth parts; as if you would prefix before the Figure 3 a point (.) or prick thus (.3) it is then decreaſed from 3 Units or Integers, to (3) three tenth parts of an Unit or Integer; and if you prefix a point and cypher thus (.03) it is decreaſed from 3 Integers to 3 hundredth parts of an Integer, and by this means 5 *l.* Abſolute by prefixing of a point will be decreaſed to 5 *l.* Negative which is 5 tenth parts of a Pound, equal in value to ten ſhillings, and ſo by prefixing of more Cyphers or Digits, its value is decreaſed in a decuple proportion *ad infinitum.* As in the following Scheme, or rather order of Numbers, we have placed (0) Cypher in its due place and order, as it is both the beginning and medium of Number; for going from (0) towards the left hand you deal with Intire, Abſolute, Whole increaſing Numbers.

Increaſing Numbers. | *Decreaſing Numbers.*

29	876	543	256	2 1 0 1 2	345	678	976	3
mm	mmm	mmm	mmm	CXUXC	mmm	mmm	mmm	m
mm	mmm	mmm	CX		XC	mmm	mmm	m
mm	mmm	CX				XC	mmm	m
mm	CX						XC	
X								

But going from (0) the place of Units towards the right hand, you meet with broken, Negative, Fractional and Decreaſing Num-

Numbers. And hence it follows that Multiplication increaſeth the product in Abſolute Numbers, but decreaſeth the Product in Negative Numbers; Alſo Diviſion decreaſeth the Quotient in whole Numbers, and increaſeth it in Negative or Fractional Numbers.

14. An Abſolute, intire, Whole, Increaſing *number*, hath always a point annexed towards the right hand, and therefore,

15. A Negative, Broken, Decimal, Decreaſing *number*, hath always a point prefixed before it towards the left hand. When we expreſs Integers, or whole *number*, as 5 *pounds*, 5 *feet*, 26 *men*, we uſually annex a point, or prick after the Number

l. feet. men. inch.

thus, 5. 5. 26. 347. But when we expreſs Decimals, or Numbers that are denyed to be intire, as decreaſing *Numbers*, we do commonly prefix a point, or prick before the ſaid Decimal or decreaſing *number*, thus (.3) that is 3 tenths, or 3 primes .03, that is 3 hundredths, or 3. ſeconds.

16. A whole or abſolute *number* is an Unit or a compoſed Multitude of Units, and it is either a prime, or elſe a compounded *number*.

17. Prime *numbers* amongſt themſelves are thoſe which have no multitude of units

for a common meaſurer, as 8 and 7 or 10 and 13, becauſe not any multitude of units can equally meaſure or divide them without a Remainder.

18. Compound *numbers* amongſt themſelves are thoſe which have a multitude of units for a common meaſurer, as 9 and 12, becauſe 3 meaſures them exactly, and abbreviates them to 3 and 4.

19. A Broken *number* commonly called a Fraction, is a part or parts of a whole *number*, *viz.* a part of an Integer, as $\frac{1}{3}$ one third is one third part of an unit.

20. A broken *number* or Fraction, conſiſts of 2 parts, *viz.* the Numerator and the Denominator.

21. The Numerator and Denominator of a Fraction, are ſet one over the other, with a line between them; and the Numerator is ſet above the line, and expreſſeth the parts therein contained.

22. The Denominator of a Fraction is the Inferior *number* placed below the line, and expreſſeth the number of parts into which the unit or Integer is divided; as let $\frac{3}{4}$ be the Fraction given, ſo ſhall 3 be the numerator, and doth expreſs or *number* the multitude of parts contained in this fraction, for $\frac{3}{4}$ is a Fraction compoſed of Fourths, or Quarters, and the Figure 3 in *numbring* ſhews

ſhews us that in that Fraction there are 3 of thoſe fourth parts or quarters; alſo in the ſame Fraction $\frac{3}{4}$, 4 is the *denominator* and doth expreſs the Quality of the Fraction, *viz.* that the whole, or integer, is here divided into 4 equal parts.

23. A broken *number* is either Proper or Improper; *viz.* Proper, when the *numerator* is leſſer than the *denominator*; ſo $\frac{3}{4}$ is a perfect proper Fraction: But an improper Fraction hath its *numerator* greater, or at leaſt equal to the *denominator*; thus, $\frac{13}{8}$ is an improper Fraction: the Reaſon is given in the Definition.

24. A proper broken *number*, is either *Simple*, or *Compound*; *viz.* *Simple*, when it hath one *Denomination*, and *Compound* when it conſiſteth of diverſe *Denominations.* If $\frac{3}{4}$ *l.* $\frac{6}{12}$ *l.* $\frac{25}{100}$ *l.* were given, we ſay they are either of them ſingle or *ſimple* Fractions becauſe they conſiſt but of one *numerator* and one *denominator*; but if $\frac{3}{4}$ of $\frac{9}{12}$ of $\frac{35}{100}$ of a pound ſterling were given, we ſay that it is a *compound broken number*, or *fraction*, becauſe the expreſſion and repreſentation, conſiſteth of more *denominations* than one; and ſuch by ſome are called *Fractions of Fractions*, and they have always this Particle (of) between them.

25. When

25. When a ſingle *broken Number* or *fraction*, hath for his *denominator* a *number* conſiſting of a unit in the firſt place towards the left hand, and nothing but Cyphers from the Unit towards the right hand, it is then the more aptly and rightly called a decimal Fraction; under this head are all our decreaſing *numbers* placed, and in our 13*th definition* called Negative, and by that order there preſcribed, we order them to be *Decimals* by ſigning a point or prick before them, or the *numerator* rejecting the *denominator*: Therefore according to our laſt Rule, $\frac{5}{10}$ $\frac{5}{100}$ $\frac{25}{100}$ $\frac{25}{1000}$ are ſaid to be *Decimals*; and a *Decimal Fraction* may be expreſſed without its *denominator* (as before) by prefixing a point or prick before the *numerator* of the ſaid *Fraction*, and then ſhall the former *Fraction* $\frac{5}{10}$ and $\frac{25}{100}$ ſtand thus .5 and .25.

But oftentimes as in the ſecond and 4*th.* fractions $\frac{5}{100}$ and $\frac{25}{10000}$, a prick or point will not do without the help of a cypher or cyphers prefixed before the ſignificant figures of the *numerator*, and therefore when the *numerator* of a *decimal fraction*, conſiſteth not of ſo many places, as the *denominator* hath cyphers, fill up the void places of the *numerator*, with prefixing Cyphers before the ſignificant figures of the *numerator*, and

then

then ſign it for a *decimal*, ſo ſhall $\frac{5}{100}$ be .05 and $\frac{25}{1000}$ will be .025 and $\frac{72}{10000}$ will be .0072. Now by this we may eaſily diſcover the *denominator* having the *numerator*; for always the denominator of any *decimal fraction* conſiſts of ſo many Cyphers, as the *numerator* hath places, with a unit prefixed before the ſaid Cyphers, *viz.* under the point or prick.

26. A *Decimal Number* or *Fraction*, is that which is expreſſed by *Primes*, *Seconds*, *Thirds*, *Fourths*, &c. and is Number decreaſing. Here inſtead of *Natural* and *Common Fractions*, as $\frac{3}{4}$ of a thing, we order the thing or Integer into *Primes*, *Seconds*, *Thirds*, *Fourths*, *Fifths*, &c. that our expreſſion may be conſonant to our former order.

27. In *Decimal Arithmetick*, we always imagin (and it would be very commodious if it were really ſo) that all intire ~~units~~, Integers, and things are divided ~~firſt~~ into ten equal parts, and theſe ~~parts~~ ſo divided we call *Primes*; ~~and ſec~~ondly; we divide alſo each of the former *Primes* into other ten equal parts, and every of theſe diviſions we call ſeconds; and thirdly, we divide each of the ſaid Seconds into ten other equal parts, and thoſe ſo divided we call *Thirds* and ſo by decimating the former and ſub-decimating

mating theſe latter, we run on *ad infinitum.*

28. Let a pound ſterling, Troy weight, Averdupois weight, Liquid Meaſure, Dry meaſure, Long meaſure, time, dozen or any other thing, or Integer be given to be *decimally* divided; in this notion premiſed, we ought to let the firſt Diviſion be *Primes*, the next diviſion *Seconds*, the next *Thirds*, &c. So one pound Sterling being 20 ſhillings, which divided into ten equal parts, the value of each part will be two ſhillings; therefore one *Prime* of a Pound ſterling will ſtand thus (.1) which is in value 2 ſhillings, Three *Primes* will ſtand thus (.3) and that is in value 6 ſhillings. Again a *Prime* or .1 being divided into ten equal parts, each of thoſe parts will be one *Second*, and is thus expreſſed, (.01) and its Value will be found to be 2d. farthing and $\frac{6}{10}$ of a farthing; and ſo will .05 ſignifie one ſhilling, or five *Seconds*. And if .01 be divided into ten other equal Parts, each of thoſe parts ſo divided will be *Thirds*, and will ſtand thus .001, and its Value will be found to be 96 of a Farthing, or $\frac{96}{100}$ of a Farthing; and 009 *Thirds* will be 2d. and .64 of a Farthing, or $\frac{64}{100}$ of a Farthing, &c. So that .375 l. will be found to repreſent 7s. and 6d. for the 3 *Primes* are 6 Shillings, and the 7

Seconds are 1 s. 4 d. and $\frac{8}{10}$ of a penny, and the five *Thirds* are 1 penny and $\frac{2}{10}$ of a penny, both which added together make 7 s. 6 d.

29. If you put any bulk or body, repreſenting an Integer, if it be *decimally* divided; then the parts in the firſt decimation are *Primes*, the next *Seconds*, and the next decimation is *Thirds*, the next *Fourths*, &c. As let there be given a Bullet of Lead, or ſuch like, whoſe weight let be 50 l. *Troy*, this call an Unit, Integer, or thing, then with the like weight and matter, make 10 other, the which together will be equal to 50 l. and will weigh each of them 5 l. a piece, take of the ſame matter, and equal to 5 l. make 10 more, then each of thoſe will weigh 6 ounces a piece; alſo if again you take 6 ounces and thereof make 10 other ſmall bullets each of them will weigh 12 penny weight *Troy*; and thus have you made *Primes*, *Seconds*, and *Thirds*, in reſpect of the Integer containing 50 *l. Troy* weight. So that 5 *Primes* is equal to the half maſs, and 2 *Primes* and 5 *Seconds* is a quarter of the maſs; and therefore 1 of the firſt diviſion, 2 of the ſecond diviſion, and 5 of the third diviſion, will be equal in weight to $\frac{1}{4}$ a quarter of the maſs, and contain 6 l. and 3 ounces.

30. When

30. When a *decimal Fraction* followeth a whole *number*, you are to ſeparate or part the *decimal* from the *whole number* by a point or prick; ſo if .75 followed the *whole number* 32, ſet them thus 32. 75. You will find that divers Authors have divers ways in expreſſing mixt *numbers*, as thus, 32|75 or 32 $\frac{75}{100}$ or 32.75 but you will find that 32.75 thus placed and expreſſed is fitteſt for Calculation.

31. A mixt *Number* hath 2 parts, the whole and the broken; the whole is that which is compoſed of Integers, and the broken is a Fraction annexed thereunto. So the mixt *Number* 36 $\frac{8}{12}$ being given we ſay that 36 is the whole *Number*, which is compoſed of Integers, and the $\frac{8}{12}$ is the broken *Number* annexed, which ſheweth that one of the former Integers (of that 36) being divided into 12 parts, this $\frac{8}{12}$ doth expreſs 8 of thoſe 12 parts more belonging to the ſaid 36 Integers.

32. *Denominative Numbers* are of one, or of many, and thoſe are of divers ſorts and kinds, *viz.* *Singular* called unit, as 1; and *Plural* called multitude; as, 2, 3, 4, 5; *Single* of one kind only, called *digits*, as 1, 2, 3, 4, 5, 6, 7, 8, 9, and *Compounds* of many, as 10, 11, 12, *&c.* 102, 367, *&c.*

Proportional, as ſingle, Multiple, Double, Triple,

Triple, Quadruple, *&c.* Denominate as Pounds, Shillings, Pence; Undenominate as 1, 2, 3, *&c.* Perfect as 6, 28, 496, 8128, 130816, 2096128, *&c.* Whose parts are equal to the numbers; Imperfect, unequal and more in the sum, as 12 to 1, 2, 3, 4, 6. Imperfect, unequal and less than the sum, as 8 to 1, 2, 4. Numbers Commensurable and Incommensurable, as 12 and 9 are Commensurable because three measures them both.

But 6 and 17 are Incommensurable because no one common *Number* or *measure* can measure them; Linear in form of a line, as............ Superficial in form of a Superficies or plane, as ∴∵∴ or ⁞⁞ ⁞⁞ *&c.* and number cubical or solid in form of a Cube. These two latter are otherwise called figurative numbers: There are also other numbers called Tabular, as Sines, Tangents, Secants, *&c.* Others that be called Logarithmetick or borrowed numbers, fitted to proportion for easie and speedy Calculation of all manner of Questions.

CHAP. II.

Of the Natural Division of Integers, and the ſeveral Denominations of their Parts.

1. BEfore we come to Calculation or the ordering of *Numbers* to operate any Arithmetical Queſtion propoſed, we will lay down Tables of the Denomination of ſeveral Integers; and after that (having mentioned the ſeveral Species or kinds of Arithmetick) we ſhall immediatly handle the Species of Numeration, which are the main Pillars upon which the whole Fabrick of this Art is built.

Of Money, Weights, &c.

2. The leaſt Denomination or Fraction of Money uſed in *England* is a Farthing, from

from whence is produced the following Tables, called the Table of Coyn, (*viz.*)

1 *Farth.*	make	1 *Farthing*
4 *Farth.*		1 *Penny*
12 *Pence*		1 *Shilling*
20 *Shill.*		1 *Pound*

and therefore

l.	s.	d.	qrs.
1	20	12	4
1	20	240	960
	1	12	48
		1	4

The firſt of theſe Tables, *viz.* that on the left hand is plain and eaſie to be underſtood, and therefore wants no directions. In the ſecond Table above the line you have 1 *l.* 20 *s.* 12 *d.* 4 *qrs.* whereby is meant that 1 pound is equal to 20 ſhillings, and one ſhilling is equal to 12 pence, and one penny is equal to 4 Farthings, under the line is 1 *l.* 20 *s.* 240 *d.* 960 *qrs.* which ſignifies one pound to contain 20 ſhillings, or 240 pence, or 960 Farthings; in the ſecond line below that is 1 *s.* 12 *d.* 48 *qrs.* the firſt ſtanding under the Denomination of ſhillings, whereby is to be noted that one ſhilling is equal to 12 pence, or 48 Farthings, and likewiſe that below that, one penny is equal in value to four Farthings; underſtand the like reaſon in all the following Tables of Weight, Meaſure, Time, Motion and dozen.

Of Troy Weight.

3. The leaſt Fraction or Denomination of Weight uſed in *England*, is a grain of Wheat gathered out of the middle of the Ear, and well dryed; from whence are produced theſe following Tables of Weight, called *Troy weight*.

32 *Grains of Wheat*	make	24 *Artificial grains*
24 *Artificial grains*	make	1 *Penny weight*
20 *Penny-weight*	make	1 *Ounce*
12 *Ounces*	make	1 *Pound Troy weight*

And therefore

l.	*oun.*	*p.w.*	*grains.*
1	12	20	24
1	12	240	5760
	1	20	480
		1	24

Troy weight ſerveth only to weigh Bread, Gold, Silver, and Electuaries; it alſo regulateth and preſcribeth a Form how to keep the Money of *England* at a certain ſtandard. The Goldſmiths have divided the Ounce *Troy weight* into other parts, which they generally call Mark weight; the denominative parts thereof are as followeth, *viz.* A mark (being an ounce Troy) is divided into 24 equal parts, called Carects and each Carect into 4 grains, ſo that in a mark

mark are 96 Grains; by this weight they distinguish the different fineness of their Gold, for if to the finest of Gold be put 2 Carects of Alloy (which is of Silver, Copper, or other baser metal, with which they use to mix their gold or silver to abate the fineness thereof) both making when cold but an Ounce, or 24 Carects, then this Gold is said to be 22 Carects fine, for if it come to be Refined the 2 Carects of alloy will fly away and leave only 22 Carects of pure Gold, the like to be considered of a greater or lesser quantity; and as the fineness of Gold is estimated by Carects, so the fineness of Silver is distinguished by ounces; for if a pound of it be pure, and looseth nothing in the Refining, such silver is said to be twelve ounces fine, but if it loseth any thing, it is said to contain so much fineness as the loss wanteth of 12 ounces, as if it lose an ounce it is said to be 11 Ounces fine, and if it lose one Ounce 14 penny weight, then it is said to be 10 Ounces 6 penny weight fine, and that which loseth two Ounces four Penny weight 16 grains is said to be nine ounces 15 Penny weight 8 grains fine, *&c.* the like of a greater or lesser quantity.

Of Apothecaries Weights.

4. The *Apothecaries* have their Weights deduced

deduced, from Troy weight, a pound *Troy*, being the greatest Integer, a Table of whose division and sub-division followeth, *viz.*

			And therefore
1 *pound*	makes	12 *ounces*	*l.* *oun.* *dram.* *scrup.* *gr.*
1 *ounce*		8 *drams*	1---12---8---3---20
1 *dram*		3 *scruples*	1---12---96---288---5760
1 *scrup.*		20 *grains*	1---8---24---480
			1---3---60
			1---20

5. Thus much concerning *Troy weight*, and its derivative weights (which as was said before) serveth to weigh Bread, Gold, Silver, and Electuaries; now besides *Troy Weight* there is another kind of weight used in *England*, commonly known by the name of *Averdupois* weight (a pound of which is equal to 14 ounces, 12 penny weight *Troy weight*) and it serveth to weigh all kinds of Grocery Wares, as also Butter, Cheese, Flesh, Wax, Tallow, Rozen, Pitch, Lead, and all such kind of garbel, the Table of which weight is as followeth.

The

The Table of Averdupois Weight.

4 *quarters of a dram*	*make*	1 *dram*
16 *drams*		1 *ounce*
16 *ounces*		1 *pound*
28 *pounds*		1 *quarter of a hundred*
4 *quarters*		1 *hund. weight, or* 112 *l.*
20 *hundred*		1 *Tun.*

And therefore

Tun	*C.*	*qrs.*	*l.*	*oun.*	*dra.*	*qrs.*
1	20	4	28	16	16	4
1	20	80	2240	35840	573440	2293760
	1	4	112	1792	28672	114688
		1	28	448	7168	28672
			1	16	256	1024
				1	16	64
					1	4

Wool is weighed with this Weight, but only the Divisions are not the same; A Table whereof followeth.

A Table

A Table of the denominative Parts of Wool-weight.

7 *Pounds*	make	1 *Clove*
2 *Cloves*	make	1 *Stone*
2 *Stone*	make	1 *Todd*
6 *Todd* 1 *Stone*	make	1 *Wey*
2 *Weyes*	make	1 *Sack*
12 *Sacks*	make	1 *Last*

And therefore

Last	*Sacks*	*Wey*	*Todd*	*Stone*	*Cloves*	*l.*
1	12	2	$6\frac{1}{2}$	2	2	7
1	12	24	156	312	624	4368
	1	2	13	26	52	364
		1	$6\frac{1}{2}$	13	26	182
			1	2	4	28
				1	2	14
					1	7

Note that in ſome Countrys the *Wey* is 256 l. *Averdupois*, as is the *Suffolk Wey*; But in *Eſſex* there is 336 *l.* in a *Wey*.

6. The leaſt Denominative part of Liquid meaſure is a Pint, which was formerly taken from *Troy weight*, (a Pound of Wheat *Troy weight* making 1 pint of liquid meaſure) but in regard of the Difference between the Brewers and the Farmers of his Majeſty's Exciſe

Excise concerning the gauging of Vessels, occasioned by the different Opinions of Artists, concerning the solid Inches in a Gallon; it was lately decided by Act of Parliament, the Statute making 282 solid Inches in a Beer-Gallon, and 231 in a Wine-Gallon, and consequently the Pint Beer-Measure to contain $35\frac{1}{4}$ solid Inches, and the Pint Wine-measure to contain $28\frac{7}{8}$ cubical or solid Inches, from whence is drawn the following Table.

The Table of Liquid Measure.

$35\frac{1}{4}$ *cubical Inch.*	make	1 *pint beer measure*
$28\frac{7}{8}$ *cubical Inch.*	make	1 *pint wine measure*
2 *pints*	make	1 *quart*
2 *quarts*	make	1 *pottle*
2 *pottles*	make	1 *gallon*
8 *gallons*	make	1 *firk. of ale, soap, or herr.*
9 *gallons*	make	1 *firkin of beer*
10 *gall. and a half*	make	1 *firk. of Salmon or Eels*
2 *firkins*	make	1 *Kilderkin*
2 *kilderkins*	make	1 *barrel*
42 *gallons*	make	1 *Tierce of wine*
63 *gallons*	make	1 *hogshead*
2 *hogsheads*	make	1 *pipe or butt*
2 *pipes or butts*	make	1 *Tun of wine*

C And

And therefore,

Tun	*pipes*	*hhds*	*gall.*	*pts.*
1	2	2	63	8
1	2	4	252	2016
	1	2	126	1008
		1	63	504
			1	8
				1

7. The leaſt Denominative part of dry meaſure is alſo a pint, and this is likewiſe taken from *Troy weight*. The Table of whoſe diviſion followeth.

The Table of Dry Meaſure.

1 *pint*	make	1 *pint*
2 *pints*	make	1 *quart*
2 *quarts*	make	1 *pottle*
2 *pottles*	make	1 *gallon*
2 *gallons*	make	1 *peck*
4 *pecks*	make	1 *buſhel*
4 *buſhels*	make	1 *Comb*
2 *Combs*	make	1 *quarter*
4 *quarters*	make	1 *Chaldron*
5 *quarters*	make	1 *Wey*
2 *Weys*	make	1 *Laſt*

And therefore,

last	*wey*	*qrs*	*com.*	*bush.*	*peck*	*gall.*	*pints*
1	2	5	2	4	4	2	8
1	2	10	20	80	320	640	5120
	1	5	10	40	160	320	2560
		1	2	8	32	64	512
			1	4	16	32	256
				1	4	8	64
					1	2	16
						1	8

8. The least Denominative part of *Long Measure* is a Barley Corn well dryed and taken out of the middle of the Ear: whose Table of Parts followeth.

The Table of Long Measure.

3 *barly corns*	make	1 *inch*
12 *inches*		1 *foot*
3 *Feet*		1 *yard*
3 *feet* 9 *inches* or *yard and quart.*		1 *Ell English*
6 *feet*		1 *fathom*
5 *yards and an half*		1 *pole or perch*
40 *poles or perches*		1 *furlong*
8 *furlongs.*		1 *English mile*

And Therefore,

mile	*furl.*	*poles*	*yards*	*feet*	*inches*	*barl.corns*
1	8	40	$5\frac{1}{2}$	3	12	3
1	8	320	1760	5280	63360	190080
	1	40	220	660	7920	23760
		1	$5\frac{1}{2}$	$16\frac{1}{2}$	198	594
			1	3	36	108
				1	12	36
					1	3

And note that the yard as alſo the ell, is uſually divided into 4 quarters, and each quarter into 4 Nails.

Note alſo, that a Geometrical Pace is 5 feet; and there are 1056 ſuch paces in an *Engliſh* mile.

9. The parts of the Superficial meaſures of land are ſuch as are mentioned in the following Table, *viz.*

The Table of Land Meaſure.

40 *Square Poles or Perches*	make	1 *Rood or quarter of an Acre.*
4 *Roods*	make	1 *Acre.*

By the foregoing Table of long Meaſure, you are informed what a pole, or (which is all one) perch is; and by this that 40 ſquare perches are 1 Rood. Now a ſquare perch

is a Superficies very aptly resembled by a square Trencher, every side thereof being a Perch or 5 Yards and a half in length, 40 of them is a Rood, and 4 Roods an Acre. So that a Superficies that is 40 perches long and 4 broad is an Acre of Land, the Acre containing in all 160 square Perches.

10. The least denominative part of Time is a Minute, the greatest Integer being a Year; from whence is produced this following Table.

The Table of Time.

1 *Minute*	make	1 *Minute*
60 *Minutes*		1 *Hour*
24 *Hours*		1 *Day natural*
7 *Days*		1 *Week*
4 *Weeks*		1 *Month*
13 *Months* 1 *day & 6 hours.*		1 *Year.*

But the Year is usually divided into 12 unequal Kalendar Months, whose names and the number of Days that they contain follow, *viz.*

	days
January	31
February	28
March	31
April	30
May	31
June	30
July	31
August	31
September	30
October	31
November	30
December	31

So that the Year containeth 365 Days, and 6 Hours, but the 6 Hours is not reckoned but only every 4*th.* year, and then there is a day added to the latter end of *February*, and then it containeth 29 days, and that year is called Leap-year, and containeth 366 days.

And here note that as the Hour is divided into 60 Minutes, so each Minnte is subdivided into 60 *Seconds*, and each *Second* into 60 *Thirds*, and each *Third* into 60 *Fourths*, &c.

The Tropical Year by the exactest observations of the most accurate Astronomers is found to be 365 Days, 5 Hours, 49 Minutes, 4 *Seconds*, and 21 *Thirds*.

CHAP.

CHAP. III.

Of the Species or Kinds of Arithmetick.

1. ARithmetick is either Natural, Artificial, Analytical, Algebraical, Lineal or Inſtrumental.

2. Natural Arithmetick is that which is performed by the Numbers themſelves; and this is either Poſitive or Negative. Poſitive which is wrought by certain infallible numbers propounded, and this is either Single or Comparative; Single, which conſidereth the nature of *numbers* ſimply by themſelves; and Comparative which is wrought by *numbers* as they have Relation one to another. And the Negative part relates to the Rule of *Falſe.*

3. Artificial (by ſome called Logarithmetical) Arithmetick is that which is performed by Artificial or borrowed *numbers* invented for that purpoſe, and are called Logarithms.

4. Analytical Arithmetick, is that which ſhews from a thing unknown, to find truly that which is ſought; always keeping the Species without Change.

5. Algebraical Arithmetick, is an obſcure and hidden Art of accompting by numbers in reſolving of hard Queſtions.

6. Lineal Arithmetick, is that which is performed by lines fitted to proportions, as alſo Geometrical projections.

7. Inſtrumental Arithmetick, is that which is performed by Inſtruments, fitted with Circular and Right lines of Proportions, by the motion of an Index or otherwiſe.

8. The parts of ſingle Arithmetick are Numeration and the Extraction of Roots.

9. Numeration is that which by certain known numbers propounded, we diſcover another number unknown.

10. Numeration hath four Species; *viz.* Addition, Subſtraction, Multiplication, and Diviſion.

CHAP.

CHAP. IV.

Of Addition of whole Numbers.

1. ADdition is the Reduction of two, or more *numbers* of like kind together into one Sum or Total. Or it is that by which divers *numbers* are added together, to the end that the Sum or Total value of them all may be discovered.

The first *number* in every addition is called the Addible *number*, the other, the *number* or *numbers* added, and the *number* invented by the *Addition* is called the *Aggregate* or *Sum* containing the value of the *Addition*.

The Collation of the *numbers*, is the right placing of the *numbers* given respectively to each denomination; and the Operation is the Artificial adding of the *numbers* given together in order to the finding out of the *Aggregate* or Sum.

2. In Addition, place the *Numbers* given reſpectively the one above the other, in ſuch ſort, that the like degree, place, or denomination may ſtand in the ſame Series, *viz.* Units under Units, Tens under Tens, Hundreds under Hundreds, &c. Pounds under Pounds, Shillings under Shillings, Pence under Pence, &c. Yards under Yards, Feet under Feet, &c.

3. Having thus placed the *numbers* given (as before) and drawn a line under them, add them together, beginning with the leſſer Denomination, *viz.* at the right hand and ſo on, ſubſcribing the ſum under the line Reſpectively; as for Example.

Let there be given 3352 and 213 and 133 to be added together, I ſet the Units in each particular *number* under each other, and ſo likewiſe the Tens under the Tens, &c. and draw a line under them as in the Margent, then I begin at the place of Units and add them together upwards ſaying, 3 and 3 are 6 and 2 make 8, which I ſet under the line, and under the ſame Figures added together; the I proceed to the next place, being the place of Tens, and add them up in the ſame manner as I did the place of Units, ſaying 3 and 1 are 4 and 5 are 9, which I likewiſe

$$\begin{array}{r} 3352 \\ 213 \\ 133 \\ \hline 3698 \end{array}$$

ſet

ſet under the line reſpectively ; then I go to the place of Hundreds, and add them up as I did the other, ſaying 1 and 2 are 3 and 3 are 6, which I alſo ſet under the line; and laſtly I go to the place of Thouſands, and becauſe there are no other figures to add to the 3, I ſet it under the line in its reſpective place, and ſo the work is finiſhed ; and I find the ſum of the 3 given numbers to be 3698.

4. But if the Sum of the Figures of any Series exceeds ten, or any *number* of tens, ſubſcribe under the ſame the Exceſs above the tens, and for every ten carry one to be added to the next Series towards the left hand, and ſo go on until you have finiſhed your addition ; always remembring, that how great ſoever the ſum of the figures of the laſt Series is, it muſt all be ſet down under the line reſpectively. So 3678 being given to be added to 2357, I ſet them down as is before directed, and as you ſee in the margent with a line drawn under them; then I begin and add them together, ſaying 7 and 8 are 15, which is 5 above ten, wherefore I ſet 5 under the line and carry 1 for the ten to be added to the next Series, ſaying 1 that I carried and 5 is 6 and 7 are 13, wherefore I ſet down 3 and carry 1 (for the ten) to the next Series,

3678
2357
——
6035

then

then I say 1 that I carried and 3 are 4 and 6 are ten, now because it comes to just 10 and no more I set 0 under the line and carry 1 for the ten to the next, and say, 1 that I carried and 2 are 3 and 3 are 6, which I set down in its Respective place, thus the addition is ended, and the total Sum of these *numbers* is found to be 6035, several Examples of this kind follow.

$$\textit{Numbers to be added}\left\{\begin{array}{r}354867\\573846\\785946\\347205\\\hline\end{array}\right.$$

Sum 2061864

$$\textit{Numbers to be added.}\left\{\begin{array}{r}748647\\465834\\76483\\648300\\\hline\end{array}\right.$$

Sum 1939264

$$\textit{Numbers to be added.}\left\{\begin{array}{r}45346\\38074\\8437\\923\\76\\\hline\end{array}\right.$$

Sum 92856

5. If the Numbers given to be added are contained under divers denominations; as of Pounds, Shillings, Pence and Farthings; or of Tuns, Hundreds, Quarters, Pounds, *&c.* Then in this case having disposed of the *Numbers*, each Denomination under other

ther of like kind; begin at the leaſt denomination, (minding how many of one denomination do make an Integer in the next) and having added them up, for every Integer of the next greater denomination that you find therein contained, bear an unit in mind to be added to the ſaid next greater denomination, expreſſing the exceſs reſpectively under the line, proceed in this manner until your addition be finiſhed; the following Examples will make the Rule plain to the learner. Thus theſe ſeveral ſums being given to be added, *viz.* 136 *l.* 13 *s.* 4 *d.* 2 *qrs.* and 79 *l.* 07 *s.* 10 *d.* 3 *qrs.* and 33 *l.* 18 *s* 09 *d.* 1 *qrs.* alſo 15 *l.* 9 *s.* 5 *d.* 0 *qrs.* The *numbers* being diſpoſed according to order will ſtand as in the Margent. Then I begin at the denomination of Farthings and add them up, ſaying 1 and 3 are 4 and 2 make 6, now I conſider that 6 Farthings is 1 penny and 2 Farthings, wherefore I ſet down the 2 Farthings in its place under the line, and keep 1 in mind to be added to the next denomination of Pence; then I go on, ſaying 1 that I carried and 5 are 6 and 9 are 15 and 10 are 25 and 4 are 29, now I conſider that 29 pence are 2 ſhillings and 5 pence, wherefore I ſet the

l.	s.	d.	qrs.
136	13	04	2
79	07	10	3
33	18	09	1
15	09	05	0
265	09	05	2

the 5 pence in order under the line and keep 2 in mind for the 2 ſhillings, to be added to the ſhillings; then I go on ſaying, 2 that I carried and 9 are 11, and 18 are 29, and 7 are 36, and 13 are 49; then I conſider that 49 ſhillings are 2 Pounds and 9 ſhillings, wherefore I ſet the 9 ſhillings under the line, and carry 2 for the two pounds, to the next and laſt denomination of Pounds, and proceed ſaying, 2 that I carried, and 5 make 7, and 3 are 10, and 9 are 19, and 6 are 25; I then ſet down 5 and carry 2 for the 2 tens, and proceed ſaying, 2 that I carry and 1 is 3, and 3 are 6, and 7 are 13, and 3 make 16; I ſet down 6 and carry 1 for the ten, and go on ſaying, 1 that I carried and 1 are 2, which I ſet in its place under the line, and the work is finiſhed; and thus I find the Sum of the fore-ſaid *Numbers* to be 265 *l.* 09 *s.* 05 *d.* 02 *qrs.* This to the ingenious Practitioner is ſufficient, but I ſhall (for the further illuminating of weaker apprehenſions) explain the operation of another example in *Troy weight*; and here the Learner muſt take notice of the Table of *Troy weight* mentioned, or ſet down in the third Section of the ſecond Chapter. The *numbers* given in this Example, are 38 *l.* 7 *oz.* 13 *p.w.* 18 *gr.* And 50 *l.* 10 *oz.* 10 *p.w.* 12 *gr.* And 42 *l.* 08 *oz.* 05 *p.w*, 16 *gr.* And

in order to the Addition thereof, I place them as you ſee, and proceed to operation; ſaying, 16 and 12 are 28, and 18 are 46; now becauſe 24 *grains* make 1 *penny weight*, 46 *grains* are 1 *penny weight* and 22 *grains*; wherefore I ſet down 22, and carry 1 for the *penny weight*, and going on I ſay 1 that I carry and 5 make 6, and 10 are 16, and 13 are 29, which is 1 ounce and 9 *penny weight*; I ſet down 9 in its place under the line, and carry 1 to the ounces, ſaying, 1 that I carry and 8 are 9, and 10 are 19, and 7 are 26, and becauſe 26 *ounces* make 2 *pound* 2 *ounces*, I ſet down 2 for the *ounces*, and carry 2 to the *pounds*; going on, 2 that I carry and 2 are 4, and 8 make 12, that is 2 and go 1; then 1 I carry and 4 are 5, and 5 are 10 and 3 are 13, which I ſet down as in the Margent, and the work is finiſhed, and I find the ſum of the ſaid *numbers* to amount to 132 *l.* 02 *oz.* 09 *p.w.* 22 *gr.* This is ſufficient for the underſtanding of the following Examples, or any other that ſhall come to thy View. The Way of proving theſe or any Sums in this Rule is ſhewed immediately after the enſuing Examples.

l.	*oz.*	*p.w.*	*gr.*
38	07	13	18
50	10	10	12
42	08	05	16
132	02	09	22

Addition of English Money.

l.	s.	d.	qrs.	l.	s.	d.	qrs.
436	13	07	1	48	15	11	1
184	09	10	3	76	10	07	3
768	17	04	2	18	00	05	3
564	11	11	0	24	19	09	2
1954	12	09	2	168	06	10	1

Addition of Troy Weight.

l.	oun.	p.w.	gr.	l.	oun.	p.w.	gr.
15	07	13	12	145	09	12	18
18	06	04	20	726	08	14	10
11	10	16	18	380	07	06	13
09	04	10	22	83	10	16	20
19	11	18	04	130	00	10	12
22	00	00	00	74	07	15	00
97	05	04	04	1541	08	16	01

Addition of Apothecaries Weights.

l.	oun.	dr.	scr.	gr.	l.	oun.	dr.	scr.	gr.
48	07	1	0	14	60	03	4	0	10
74	05	5	2	10	48	10	6	0	14
64	10	7	1	16	34	08	2	1	15
17	08	1	0	11	18	11	2	2	11
34	09	6	1	09	160	07	1	2	15
					35	02	5	1	07
240	05	6	1	00	358	07	7	0	12

Addition of Averdupois weight.

Tun	C.	qrs.	l.	l.	oun.	dr.
75	13	1	15	36	10	12
48	07	3	21	22	11	13
60	11	1	17	11	07	04
21	07	0	25	15	04	10
12	16	0	11	20	00	09
218	16	0	05	106	03	00

Addition of Liquid Measure.

Tun	Pipe	hhd.	gall.	Tun	hhds	gall.	pts.
45	1	1	48	30	3	40	4
15	0	1	17	12	0	28	6
38	0	0	47	47	5	60	5
12	1	0	56	57	3	22	3
21	1	1	18	17	0	00	0
133	1	1	60	166	1	26	2

Addition of Dry Measure.

Chald.	qrs.	bush.	pec.	qrs.	bush.	pec.	gall.
48	3	7	3	17	3	1	1
13	1	4	0	50	1	3	0
54	0	6	2	14	5	3	1
16	3	6	1	40	2	0	1
40	1	0	1	30	0	3	0
173	3	0	3	152	5	3	1

Addition

Addition of Long Measure.

yds.	*qrs.*	*Na.*	*ells.*	*qrs.*	*na.*
35	3	3	56	1	3
14	1	2	13	3	2
74	2	3	48	2	1
38	0	1	50	1	0
30	1	0	74	0	2
15	0	0	17	1	0
218	1	1	260	2	0

Addition of Land Measure.

Acre	*Rood*	*per.*	*Acre*	*Rood*	*per.*
12	3	18	86	1	36
14	0	24	47	3	24
30	2	19	73	2	18
48	3	30	60	0	07
28	1	38	04	2	08
50	3	26	14	1	14
185	3	35	286	3	27

The Proof of Addition.

6. *Addition* is proved after this manner, when you have found out the Sum of the *Numbers* given, then ſeparate the uppermoſt line from the reſt, with a ſtroke or daſh of the pen, and then add them all up again as you

you did before, leaving out the uppermoſt line, and having ſo done add this new invented Sum to the uppermoſt line you ſeparated, and if the Sum of thoſe two lines be equal to the ſum firſt found out, then the work was performed true, otherwiſe not: As for Example, let us prove the firſt example of *Addition* of Money whoſe ſum we found to be 265 *l.* 9 *s.* 5 *d.* 2 *qrs.* and which we prove thus, having ſeparated the uppermoſt number from the reſt, by a line as you ſee in the margent, then I add the ſame together again leaving out the ſaid uppermoſt line, and the ſum thereof I ſet under the firſt Sum or true Sum, which doth amount to 128 *l.* 16 *s.* 01 *d.* 2 *qrs.* then again I add this new Sum to the uppermoſt line that before was ſeparated from the reſt, and the Sum of theſe two is 265 *l.* 09 *s.* 05 *d.* 2 *qrs.* the ſame with the firſt Sum, and therefore I conclude that the Operation was rightly performed.

l.	*s.*	*d.*	*qrs.*
136	13	04	2
79	07	10	3
33	18	09	1
15	09	05	0
265	09	05	2
128	16	01	0
265	07	05	2

7. The

7. The main end of *Addition* in Questions Resolvable thereby, is to know the Sum of several debts, parcels, integers, &c. some Questions may be these that follow,

Quest. 1. There was an old man whose age was required, to which he replied, I have seven Sons, each having two years between the birth of each other, and in the 44 year of my age my eldest Son was born, which is now the age of my youngest; I demand what was the old man's age?

Now to resolve this Question, first set down the Fathers age at the birth of his first Child, which was 44, then the Difference between the eldest and the youngest, which is 12 years, and then the age of the youngest which is 44, and then add them all together, and their Sum is 100, the compleat age of the Father.	44 12 44 —— 100

Quest. 2. A man lent his Friend, at several times, these several Sums, (*viz.*) at one time 63 *l.* at another time 50 *l.* at another time 48 *l.* at another time 156 *l.* now I desire to know how much was lent him in all.

Set

Set the Sums lent one under another as you ſee in the Margent, and then add them together, and you will find their Sum to amount to 317 *l.* which is the Total of all the ſeveral Sums lent, and ſo much is due to the Creditor.

l.
63
50
48
156
317

Queſt. 3. From *London* to *Ware* is 20 miles, thence to *Huntington* 29 miles, thence to *Stanford* 21 miles, thence to *Tuxford* 36 miles, thence to *Wentbridge* 25 miles, from thence to *York* 20 miles. Now I deſire to know how many miles it is from *London* to *York* according to this Reckoning?

Now to anſwer this Queſtion, ſet down the ſeveral Diſtances given, as you ſee in the margent, and add them together, and you will find their Sum to amount to 151, which is the true Diſtance in miles between *London* and *York*.

20
29
21
36
25
20
151

Queſt. 4. There are 2 numbers the leaſt whereof is 40, and their Difference is 14, I deſire to know what is the greater number, and alſo what is the Sum of them both?

First

First set down the least, *viz.* 40, and 14 the difference, and add them together, and their sum is 54 for the greatest number, then I set (40 the least) under 54 (the greatest) and add them together, and their Sum is 94 equal to the greatest and least numbers.

	40
	14
greatest	54
least	40
sum	94

CHAP. V.

Of Substraction of whole Numbers.

1. *Substraction* is the taking of a lesser number out of a greater of like kind, whereby to find out a third number, being or declaring the inequality, excess, or difference between the numbers given; or *Substraction* is that by which one number is taken out of another number given, to the end

end that the reſidue, or remainder may be known, which remainder is alſo called the *Reſt*, *Remainder*, or *Difference* of the numbers given.

2. The number out of which *Subſtraction* is to be made, muſt be greater, or at leaſt equal with the other Number given, the higher or ſuperior number is called the major number, and the lower or inferior is called the minor number, and the operation of *Subſtraction* being finiſhed, the Reſt or Remainder is called the Difference of the numbers given.

3. In *Subſtraction* place the numbers given reſpectively, the one under the other, in ſuch ſort as like degrees, places, or denominations may ſtand in the ſame Series, *viz.* Units under Units, Tens under Tens, *&c.* Pounds under Pounds, *&c.* Feet under Feet, and Parts under Parts, *&c.* This being done draw a line underneath, as in *Addition.*

4. Having placed the *numbers* given as is before directed, and drawn a line under them, ſubſtract the lower number (which in this caſe muſt always be leſſer than the uppermoſt) out of the higher *number*, and ſubſcribe the difference, or remainder, reſpectively below the line; and when the Work is finiſhed, the number below the line

line will give you the Remainder; As for Example, let 364521 be given to be Subſtracted from 795836, I ſet the leſſer under the greater as in the margent, and draw a line under them, then beginning at the Right hand, I ſay 1 out of 6 and there remains 5, which I ſet in order under the line; then I proceed to the next, ſaying 2 from 3 reſts 1, which I note alſo under the line, and thus I go on until I have finiſhed the Work, and then I find the Remainder or Difference to be 431315.

795836
364521
431315

5. But if it ſo happen (as commonly it doth) that the lowermoſt *number* or figure is greater than the uppermoſt; then in this caſe, add ten to the uppermoſt *number*, and Subſtract the ſaid lowermoſt *number*, from their Sum, and the remainder place under the line, and when you go to the next figure below, pay an unit by adding it thereto for the 10 you borrowed before, and ſubſtract that from the higher *Number* or Figure: And thus go on until your Subſtraction be finiſhed. As for Example; Let 437503 be given, from whence it is required to ſubſtract 153827, I diſpoſe of the *numbers* as is before directed, and as you ſee in the margent; then I begin, ſaying 7 from 3 can-

cannot, but (adding 10 thereto I ſay) 7 from 13 and there remains 6 which I ſet under the line in order; then I proceed to the next figure, ſaying 1 that I borrowed and 2 is 3 from 0 I cannot, but 3 from 10 and there remains 7 which I likewiſe ſet down as before; then one that I borrowed and eight is nine from 5 I cannot, but nine from fifteen and there remains 6; then one I borrowed and three is 4, from 7 and there remains 3; then 5 from 3 I cannot, but 5 from thirteen and there remains 8; then one I borrowed and one are two, from 4 and there reſt 2; And thus the Work is finiſhed, and after theſe *numbers* are *Subſtracted* one from another, the Inequality, Remainder, Exceſs, or Difference is found to be 283676. Examples for thy further Experience may be theſe that follow.

	437503
	153827
	283676

From	3475016	*From*	3615746
Take	738642	*Take*	5864
Reſts	2736374	*Reſts*	3609882

6. If the *Sums* or *Numbers* to be *Subſtracted*, are of ſeveral Denominations,

 place

place the lesser *Sum* below the greater, and in the same Rank and order as is shewed in Addition of the same *Numbers*; then begin at the Right hand and take the lower *number* out of the uppermost, if it be lesser; but if it be bigger than the uppermost, then borrow an unit from the next greater Denomination, and turn it into the Parts of the lesser Denomination, and add those parts to the uppermost *Number*, and from their *Sum* substract the lowermost, noting the remainder below the line; then proceed and pay 1 to the next Denomination for that which you borrowed before, and proceed in this order until the work be finished. An Example of this Rule may be this that followeth, let 375 *l.* 13 *s.* 07 *d.* 1 *qrs.* be given, from whence let it be required to *Substract* 57 *l.* 16 *s.* 03 *d.* 2 *qrs.* In order whereunto I place the *numbers* as you see in the Margent, and thus I begin at the least Denomination, saying two from one I cannot, therefore I borrow one penny from the next denomination and turn it into Farthings which is four, and adding four to one which is five, I say, but two from five and there remains three, which I put under

l.	*s.*	*d.*	*qrs.*
375	13	07	1
57	16	03	2
317	17	03	3

the

the line; then going on, I say one that I borrowed and three is four, from 7 and there Rests three; then going on, I say sixteen from thirteen I cannot, but (borrowing one pound and turning it into twenty shillings, I add it to thirteen and that is thirty three, wherefore I say) sixteen from thirty three, and there remains seventeen, which I set under the line and go on, saying one that I borrowed and seven is eight, from five I cannot but eight from fifteen and there remains seven; the one that I borrowed and five is six, from seven there rests one, and nothing from three rest three, and the work is done; And I find the remainder or difference to be 317 *l.* 17 *s.* 03 *d.* 3 *qrs.*

Another Example of *Troy Weight* may be this, I would *Substract* 17 *l.* 10 *oz.* 11 *p.w.* 20 *gr.* from 24 *l.* 05 *oz.* 00 *p.w.* 08 *gr.* I place the *numbers* according to the Rule, and begin, saying twenty from eight I cannot, but borrow one *penny weight* which is twenty four *grains*, and add them to eight and they are thirty two, wherefore I say twenty from thirty two rest twelve; then one that I borrowed and eleven is twelve, from 20 I cannot, but twelve from twenty (borrowing

l.	*oz.*	*p.w.*	*gr.*
24	05	00	08
17	10	11	20
06	06	08	12

rowing an Ounce which is twenty *penny weight*) and there remain eight; then one that I borrowed and ten is eleven, from five I cannot, but eleven from seventeen and there rest six; then one that I borrowed and seven is eight, from four I cannot, but eight from fourteen and there rest six; then one that I borrowed and one is two from two and there rests nothing; so that I find the Remainder or difference to be 6 *l.* 6 *oz.* 8 *p.w.* 12 *gr.*

7. It many times happeneth that you have many *Sums* or *Numbers* to be *Substracted* from one *number*; as suppose a man should lend his Friend a certain *Sum* of Money, and his Friend had paid him part of his debt at several times, then before you can conveniently know what is still owing, you are to add the several *Numbers* or *Sums* of Payment together, and *Substract* their *Sum* from the whole Debt, and the Remainder is the *Sum* due to the Creditor; as suppose A lendeth to B 564 *l.* 13 *s.* 10 *d.* and B hath repaid him 79 *l.* 16 *s.* 08 *d.* at one time, and 163 *l.* 18 *s.* 11 *d.* at another time, and 241 *l.* 15 *s.* 08 *d.* at another time; and you would know how the Accompt standeth between them, or what more is due to A. In order whereunto, I first set down the *Sum* which A lent

an

and draw a line underneath it, then under that line ſet the ſeveral *Sums* of payment as you ſee in the margent; and having brought the ſeveral Sums of payment into one Total by the 5*th*. Rule of the 4*th*. Chapter foregoing, I find their *Sum* amounteth to 485 *l.* 11 *s.* 3 *d.* which I ſubſtract from the Sum firſt lent by A, by the 6*th*. Rule of this Chapter, and I find the Remainder to be 79 *l.* 02 *s.* 07 *d.* And ſo much is ſtill due to A.

	l.	*s.*	*d.*
Lent	564	13	10
Paid at	79	16	08
ſeveral	163	18	11
payments.	241	15	08
paid in all	485	11	03
Remains	79	02	07

When the Learner hath good knowledge of what hath been already delivered in this and the foregoing Chapter, he will with eaſe underſtand the manner of working the following Examples.

Substraction of whole Money.

	l.	s.	d.	l.	s.	d.	qrs.
Borrowed	374	10	03	700	10	11	2
Paid	79	15	11	9	03	11	3
Remains	304	14	04	691	06	11	3

	l.	s.	d.	l.	s.	d.	qrs.
Borrowed	1000	00	00	711	03	00	0
Paid	19	00	06	11	13	00	1
Rem. due	980	19	06	699	09	11	3

	l.	s.	d.	qrs.
Borrowed	3300	00	00	0
Paid at several payments.	170	10	00	0
	361	13	10	1
	590	03	04	3
	73	04	11	3
Paid in all	1195	12	02	3
Remain due	2104	07	09	1

Substraction of Troy Weight.

	l.	oz.	p.w.	gr.
Bought	174	00	13	00
Sold	78	04	16	15
Remains	95	07	16	09

Bought

	l.	*oz.*	*p.w.*	*gr.*
Bought	470	10	13	00
Sold at several Times.	60	00	00	00
	35	10	18	00
	16	07	09	08
	48	04	00	00
	61	11	19	23
	23	00	00	00
Sold in all	245	10	07	07
Rem. unsold	225	00	05	17

Substraction of Apothecaries Weights.

	l.	*oz.*	*dr.*	*scr.*	*gr.*	*l.*	*oz.*	*dr.*	*scr.*	*gr.*
Bought	12	04	3	0	00	20	00	1	0	07
Sold	8	05	1	1	15	10	00	1	2	12
Remains	3	11	1	1	05	9	11	7	0	15

Substraction of Averdupois Weight.

	C.	*qrs.*	*l.*	*Tun*	*C.*	*qrs.*	*l.*	*oz.*	*dr.*
Bought	35	0	15	5	07	1	10	10	05
Sold	16	2	20	3	17	1	16	09	13
Rem.	18	2	23	1	09	3	22	00	08

Substraction of Liquid Measure.

	Tun	hhd	gall.	Tun	hhd	gall.	pts.
Bought	40	1	30	60	3	42	4
Sold	16	1	40	15	3	46	6
Remains	23	3	53	44	3	58	6

Substraction of Dry Measure.

	Chal.	qrs.	bush.	pec.	Ch.	qrs.	bu.	pec.
Bought	100	0	00	0	73	2	3	2
Sold	54	1	04	3	46	2	3	3
Remains	45	2	03	1	26	3	7	3

Substraction of Long Measure.

	yards	qrs.	nails	yards	qrs.	nails
Bought	160	1	0	344	0	1
Sold	64	1	2	177	1	3
Remains	95	3	2	166	2	2

Substraction of Land Measure.

	Acres	Rood	Perch.	Acres	Rood	per.
Bought	140	2	13	600	0	00
Sold	70	3	22	54	0	16
Remains	69	2	31	545	3	24

The

The Proof of Subſtraction.

8. When your *Subſtraction* is ended, if you deſire to prove your work, whether it be true or no, then add the remainder to the minor *Number*, and if the *Aggregate* of theſe two be equal to the major *Number*, then is your Operation true; otherwiſe falſe; thus let us prove the firſt *Example* of the fifth Rule of this *Chapter*, where after *Subſtraction* is ended the *numbers* ſtand as in the *Margent*; the Remainder or difference being 283676.

```
437503
153827
------
283676
```

now to prove the work, I add the ſaid remainder 283676 to the minor *number* 153827, by the fourth Rule of the foregoing *Chapter*, and I find the Sum or *Aggregate* to be 437503 equal to the major Number, or *Number* from whence the leſſer is *Subſtracted*: behold the work in the *Margent*.

```
437503
153827
------
283676
------
437503
```

The Proof of another *Example* may be of the firſt *Example* of the ſixth *Rule* of this *Chapter*, where it is required to *Subſtract* 57 *l.* 16 *s.* 03 *d.* 2 *qrs.* from 375 *l.* 13 *s.* 07 *d.* 1 *qrs.* and by the *Rule* I find the *Remainder* to be 317 *l.* 17 *s.* 03 *d.* 3 *qrs.* now to prove it, I add the ſaid *Re-*

mainder 317 *l.* 17 *s.* 03 *d.* 3 *qrs.* to the minor *number* 57 *l.* 16 *s.* 03 *d.* 2 *qrs.* and their Sum is 375 *l.* 13 *s.* 07 *d.* 1 *qrs.* equal to the major *number*, which proves the Work to be true, but if it had happened to have been either more or less than the said major *number*, then the *operation* had been false.

l.	*s.*	*d.*	*qrs.*
375	13	07	1
57	16	03	2
317	17	03	3
375	13	07	1

9. The general effect of *Substraction* is to find the difference or excess between two *numbers*, and the *Rest* when a payment is made in part of a greater Sum, the date of Books printed, the age of any thing by knowing the present year, and the year wherein they were made, created or built, and such like.

The Questions appropriated to this *Rule* are such as follow.

Quest. 1. What difference is there between one thing of 125 Foot long and another of 66 Foot long?

To resolve this Question I first set down the major or greater *number* 125, and under it the minor or lesser *number* 66, as is directed in the third *rule* of this *Chapter*, and according to the fourth Rule of

125
66
59

of the ſame I *ſubſtract* the minor from the major, and the Remainder, exceſs or diſference I find to be 59; ſee the Work in the *Margent*.

Queſt. 2. A Gentleman oweth a *Merchant* 365 *l*. whereof he hath paid 278 *l*. what more doth he owe?

To give an *Anſwer* to this *Queſtion*, I firſt ſet down the *major number*, 365 *l*. and under it I place 278 the *minor*, and *ſubſtract* the one from the other, and thereby I diſcover the Exceſs, Difference or Remainder to be 87, and ſo much is ſtill due to the *Creditor*. As *per Margent*.

$$\begin{array}{r} 365 \\ 278 \\ \hline 87 \end{array}$$

Queſt. 3. An obligation was written, a book printed, a child born, a Church built, or any other thing made, in the year of our Lord 1572, and now we Account the year of our Lord 1687, the *Queſtion* is to know the age of the ſaid things, that is, how many years are paſſed ſince the ſaid things were made; I ſay if you *ſubſtract* the leſſer *number* 1572, from the greater 1687, the Remainder will be 112, and ſo many years are paſt ſince the making of the ſaid things as by the Work in the margent.

$$\begin{array}{r} 1687 \\ 1572 \\ \hline 115 \end{array}$$

Queſt. 4. There are three Towns lie in a ſtrieght line (*viz.*) *London*, *Huntington*, and

and *York*, now the Distance between the farthest of these Towns, *viz. London* and *York* is 151 miles, and from *London* to *Huntington* is 49 miles, I demand how far it is from *Huntington* to *York*.

To resolve this *Question*, *substract* 49 the distance between *London* and *Huntington*, 151 the Distance between *London* and *York*, and the Remainder is 102, for the true Distance between *Huntington* and *York*. See the Work in the Margent.

$$\begin{array}{r} 151 \\ 49 \\ \hline 102 \end{array}$$

CHAP. VI.

Of Multiplication of whole Numbers.

1. MUltiplication is performed by two *Numbers* of like kind, for the *Production* of a third, which shall have such reason to the one, as the other hath to Unit, and in Effect is a most brief and artificial compound *Addition* of many equal *numbers* of like kind into one Sum. Or *Multiplication* is that by which we *multiply* two or

or more *numbers*, the one into the other, to the end that their Product may come forth, or be diſcovered.

Or *Multiplication*, is the increaſing of any one *number* by another, ſo often as there are Units in that *number*, by which the other is increaſed, or by having two *numbers* given to find a third, which ſhall contain one of the *Numbers* as many times as there are Units in the other.

2. *Multiplication* hath three parts, firſt the *Multiplicand*, or *number* to be *multiplied*, Secondly, the *multiplier*, or *number* given, by which the *multiplicand* is to be *multiplyed*, and Thirdly, the *product* or *number* produced by the other two, the one being *multiplied* by the other, as if 8 were given to be *multiplyed* by 4, I ſay 4 times 8 is 32, here 8 is the *multiplicand*, and 4 is the *multiplier*, and 32 is the product.

$$\begin{array}{r} 8 \\ 4 \\ \hline 32 \end{array}$$

3. *Multiplication* is either ſingle by one figure, or compound that conſiſts of many.

Single *multiplication* is ſaid to conſiſt of one figure, becauſe the *multiplicand* and *multiplier* conſiſt each of them of a Digit, and no more, ſo that the greateſt product that can ariſe by ſingle *multiplication* is 81, being

being the ſquare of 9; and Compound *multiplication* is ſaid to conſiſt of many figures, becauſe the *Multiplicand*, or *Multiplier* conſiſt of more places than one; as if I were to *multiply* 436 by 6, it is called compound, becauſe the *multiplicand* 436 is of more places than one, (*viz.*) 3 places.

4. The Learner ought to have all the varieties of ſingle *multiplication* by heart before he can well proceed any further in this Art, it being of moſt excellent Uſe, and none of the following Rules in *Arithmetick* but what have their principal dependance thereupon, which may be learnt by the following Table.

Multiplication Table.

1	2	3	4	5	6	7	8	9
2	4	6	8	10	12	14	16	18
3	6	9	12	15	18	21	24	27
4	8	12	16	20	24	28	32	36
5	10	15	20	25	30	35	40	45
6	12	18	24	30	36	42	48	54
7	14	21	28	35	42	49	56	63
8	16	24	32	40	48	56	64	72
9	18	27	36	45	54	63	72	81

The

The uſe of the precedent Table is this, In the uppermoſt line or Column you have expreſſed all the digits from 1 to 9, and likewiſe beginning at 1 and going downwards in the ſide column you have the ſame; ſo that if you would know the Product of any two ſingle *numbers* multiplied by one another, look for one of them (which you pleaſe) in the uppermoſt Column, and for the other in the ſide Column, and running your eye from each figure along the reſpective Columns, in the common *Angle* (or place) where theſe two Columns meet, there is the product required. As for Example, I would know how much is 8 times 7, firſt I look for 8 in the uppermoſt Column, and 7 in the ſide Column, then do I caſt my eye from 8 along the Column downwards from the ſame, and likewiſe from 7 in the ſide Column, I caſt my eye from thence towards the right hand, and find it to meet with the firſt Column at 56, ſo that I conclude 56 to be the Product required, it would have been the ſame if you had looked for 7 in the top, and 8 on the ſide, the like is to be underſtood of any other ſuch *numbers*. The Learner being perfect herein, it will be neceſſary to proceed.

5. In Compound *Multiplication*, if the

Multi-

Multiplicand consists of many places, and the *multiplier* of but one Figure; first set down the *multiplicand*, and under it place the *multiplier* in the place of Units and draw a line underneath them, then begin and *multiply* the *multiplier* into every particular Figure of the *multiplicand*, beginning at the place of units, and so proceed towards the left hand, setting each particular product under the line, in order as you proceed, but if any of the products exceed 10 or any number of Tens, set down the excess, and for every 10 carry a unit to be added to the next Product, always remembring to set down the Total product of the last Figure; which work being finished, the Sum or Number placed under the line shall be the true and Total product required. As for example, I would multiply 478 by 6, first I set down 478, and underneath it 6 in the Place of Units, and draw a line underneath them as in the Margent, then I begin saying 6 times 8 is 48, which is 8 above four tens,

478
6
2868

therefore I set down 8 (the excess) and bear 4 in mind for the four tens, then I proceed saying 6 times 7 is 42 and 4 that I carried is 46, I then set down 6 and carry 4, and go on saying 6 times 4 is 24, and 4 that

I

I carried is 28, and becauſe it is the laſt Figure, I ſet it all down, and ſo the work is finiſhed, and the product is found to be 2868 as was required.

6. When in Compound *Multiplication* the Multiplier conſiſteth of divers places, then begin with the Figure in the place of Units in the Multiplier, and multiply it into all the Figures in the Multiplicand, placing the product below the line as was directed in the laſt Example; then begin with the Figure of the ſecond place of the Multiplier, (*viz.*) the place of Tens, and Multiply it likewiſe into the whole Multiplicand (as you did the firſt Figure) placing its product under the product of the firſt Figure, do in the ſame manner by the third fourth, and fifth, *&c.* until you have multiplied all the Figures of the Multiplier particularly into the whole Multiplicand, ſtill placing the Product of each particular Figure under the Product of its precedent Figure; herein obſerving the following Caution.

A Caution. In the placing of the Product of each particular Figure of the Multiplier, you are not to follow the 2*d.* Rule of the 4*th.* Chapter, *viz.* not to place Units under Units, and Tens under Tens, *&c.* but to put the Figure or

Cypher

Cypher in the place of Units of the secon line under the second figure or place of Te in the line above it, and the Figure or Cy pher in the place of units of the third line un der the place of Tens in the second line, *&c.* Observing this order till you have finishe the work; *viz.* still placing the first figur of every line or product under the secon figure or place of Tens in that which wa above it, and having so done, draw a lin under all these particular products, and ad them together; so shall the Sum of all thes Products be the total Product required.

As if it were required to Multiply 76 by 27, I set them down the one under th other with a line drawn underneath them; then I begin saying seven times four is 28, then I set down 8 and carry 2, then say 7 times 6 is 42 and 2 that I carried is 44, that is 4 and go 4; then 7 times 7 is 49, and 4 that I carry is 53, which I set down because I have not another figure to multiply; Thus have I done with the 7; then I begin with the 2 saying 2 times 4 is 8, which I set down un- der (4) the second figure or place of tens in the line above it, as you may see in the margent; Then I proceed, saying 2 times 6 is 12, that is 2 and carry one, then two times

```
  764
   27
 ----
 5348
1528
-----
20628
-----
```

times ſeven is fourteen, and one that I carry is fifteen, which I ſet down becauſe 'tis the product of the laſt Figure; ſo that the product of 764 by 7 is 5348, and by 2 is 1528 which being placed the one under the other as before is directed, and as you ſee in the margent, and a line drawn under them, and they added together reſpectively, make 20628 the true Product required, being equal to 27 times 764.

Another Example may be this; Let it be required to multiply 5486 by 465, I diſpoſe of the Multiplicand and Multiplier, according to Rule, and begin multiplying the firſt figure of the *multiplier*, which is five into the whole *multiplicand*, and the *Product* is 27430; then I proceed and multiply the ſecond figure (6) of the *multiplier* into the *multiplicand*, and find the *product* to amount to 32916 which is ſubſcribed under the other *product* reſpectively, then do I Multiply the third and laſt figure (4) of the Multiplier into the Multiplicand, and the Product is 21944, which is likewiſe placed under the ſecond line reſpectively; then I draw a line under the ſaid Products (being placed the one under the other according to Rule) and add them toge-

```
   5486
    465
-------
  27430
 32916
21944
-------
2550990
-------
```

together and the Sum is 2550990 the true Product sought being equal to 5486 times 465, or 465 times 5486.

More Examples in this Rule are these following.

430865	6400758
4739	37496
3877785	38404548
1292595	57606822
3016055	25603032
1723460	44805306
	19202274
2041869235	240002821968

Compendiums in Multiplication.

7. Although the former Rules are sufficient for all Cases in Multiplication, yet because in the Work of Multiplication many times great labour may be saved, I shall acquaint the Learner with some Compendiums in order thereto, *viz.* If the Multiplicand or Multiplier, or both of them end with Cyphers, then in your multiplying you may neglect the Cyphers and multiply only the significant Figures, and to the Product of those significant Figures, add so many Cyphers as the *Numbers* given to be multiplied did end with; that

Si enumeris propositis unus vel uterque adjunctos habeat ad dextram circulos; omissis circulis fiat ipsorum numerorum multiplicatio & facto demum tot insuper integrorum loci adscribantur quot sunt omissi circuli in utroque facto e.
Clavis Ma. c. 4. 3.

that is, annex them on the Right hand of the ſaid product, ſo ſhall that give you the true product required. As if I were to multiply 32000 by 4300, I ſet them down in order to be multiplied as you ſee in the margent, but neglecting the Cyphers in both Numbers I only multiply 32 by 43 and the Product I find to be 1376, to which I annex the 5 Cyphers that are in the Multiplicand and Multiplier, and then it makes 137600000 for the true product of 32000 by 4300.

```
    32000
     4300
    -----
      96
    128
---------
137600000
```

8. If in the Multiplier, Cyphers are placed between ſignificant Figures, then multiply only by the ſignificant Figures neglecting the Cyphers, but here ſpecial notice is to be taken of the true placing of the firſt figure after the neglect of ſuch Cypher or Cyphers, and therefore you muſt obſerve in what place of the multiplier the Figure you multiply by ſtandeth, and ſet the firſt Figure of that Product under the ſame place of the product of the firſt figure of your Multiplier; As for Example, let it be required to multiply 371568 by 40007, firſt I multiply the multiplicand

Si intermedio multiplicantis loco circulus fuerit, ille negligitur. Alſted. Cap. 6. de Arithm.

by

by ſeven and the Product is 2600976, then neglecting the Cyphers, I multiply by 4 and that Product is 1486272 now I conſider that four is the fifth figure in the multiplier, therefore I place two (the firſt figure of the product by four) under the fifth place of the firſt Product by ſeven, and the reſt in order, and having added them together, the total Product is found to be 14865320976; other Examples in this Rule are theſe following.

```
    371568
     40007
 ---------
   2600976
1486272
-----------
14865320976
```

```
   327586
     6030
 --------
   982758
 1965516
 ----------
 1975343580
```

```
     7864371
       20604
  ----------
    31457484
  47186226
 15728742
 ------------
 162037500084
```

9. If you are to multiply any *Number* by an unit with Cyphers, (*viz.*) by 10, 100, 1000, *&c.* then annex ſo many Cyphers before the multiplicand, and that *Number* when the Cyphers are annexed is the Product required; as if you would multiply 428 by 100, annex two Cyphers to 428 and it is 42800: If it were required to multiply 102 by 10000, annex 4 Cyphers and

and it gives 1020000 for the Product required.

The Proof of Multiplication.

10. Multiplication is proved by Diviſion, and to ſpeak truth all other ways are falſe; and therefore it will be moſt convenient in the firſt place, to learn Diviſion, and by that to prove Multiplication. There is a Way (at this day generally uſed in Schools) to prove multiplication, which is this, firſt add all the Figures in the Multiplicand together as if they were ſimple *Numbers*, caſting away the Nines as often as it comes to ſo much, and noting the Remainder at laſt, which in this caſe cannot be ſo much as 9; Caſt likewiſe the Nines out of the multiplier as you did out of the multiplicand, and note that Remainder; then multiply the Remainders, the one by the other, and caſt the Nines out of that Product, obſerving the Remainder; and laſtly, Caſt the Nines out of the total Product, and if this Remainder be equal to the Remainder laſt found, then they conclude the Work to be rightly performed; but there may be given a thouſand (nay infinite) falſe Products in a multiplication, which

Namque eſt quod aliam expectes examinandi viam; nam alia vulgares & falſæ ſunt, & nullo ingixo fundamento. Gem. Friſ.

which after this manner may be proved to be true and therefore this way of proving doth not deſerve any Example; but we ſhall defer the Proof of this Rule till we come to prove Diviſion, and then we ſhall Prove them both together.

11. The general effect of Multiplication is contained in the definition of the ſame, which is to find out a 3*d. Number*, ſo often containing one of the two given *Numbers* as the other containeth unit.

The ſecond effect is by having the length and breadth of any thing (as a Parallelogram, or long plain) to find the ſuperficial Content of the ſame, and by having the ſuperficial content of the Baſe and the length, to find out the ſolidity of any parallelepipedon, Cylinder or other ſolid Figures.

The third Effect is by the contents, price, value, buying, ſelling, expence, wages, exchange, ſimple intereſt, gain or loſs of any one thing, be it Money, Merchandiſe, &c. to find out the value, price, expence, buying, ſelling, exchange, or intereſt of any *Number* of things of like Name, Nature and Kind.

The fourth Effect is (not much unlike the other) by the Contents, Value, or price of one part of any thing Denominated, to find out the Content, Value or price of the whole

whole thing, all the parts into which the whole is divided, multiplying the price of one of thoſe parts.

The fifth effect is, to aid, to compound, and to make other Rules, as chiefly the Rule of Proportion, called the Golden Rule, or Rule of Three; alſo by it, things of one Denomination are reduced to another.

If you multiply any Number of Integers or the price of the Integer, the Product will diſcover the price of the Quantity, or Number of Integers given.

In a Rectangular Solid, if you multiply the breadth of the Baſe by the depth, and that Product by the length, this laſt Product will diſcover the Solidity or Content of the ſame Solid.

Some Queſtions proper to this Rule may be theſe following.

Queſt. 1. What is the Content of a ſquare piece of Ground, whoſe length is 28 *perches*, and breadth 13 *perches*?

Anſwer, 364 ſquare *perches*, for multiplying 28 the length, by 13 the breadth, the Product is ſo much.

Queſt. 2. There is a ſquare battle whoſe Flank is 47 men, and the Files 19 deep,

what number of Men doth that Battel contain? *Facit* 893; for multiplying 47 by 19. the Product is 893.

Quest. 3. If any one thing cost 4 ſhillings, what ſhall 9 ſuch things coſt? *Anſwer*, 36 ſhillings; for multipying 4 by 9, the Product is 36.

Quest. 4. If a piece of Money or Merchandize be worth or coſt 17 ſhillings, what ſhall 19 ſuch pieces of Money or Merchandize coſt? *Facit* 323 ſhillings, which is equal to 16 *l.* 03 *s:*

Quest. 5. If a Soldier or Servant get or ſpend 14 *s. per* Month, what is the Wages or Charges of 49 Souldiers or Servants for the ſame time? multiply 49 by 14, the Product is 686 *s.* or 34 *l.* 06 *s.* for the *Anſwer.*

Queſt. 6. If in a day there are 24 hours, how many hours are there in a year, accounting 365 Days to conſtitute the year? *Facit* 8760 hours, to which if you add the 6 hours over and above 365 days as there is in a year, then it will be 8766 hours, now if you multiply this 8766, by 60 the Number of Minutes in an hour, it will produce 525960 for the Number of Minutes in a year.

CHAP.

CHAP. VII.

Of Diviſion of whole Numbers.

1. DIVISION is the Separation or Parting of any Number, or Quantity given, into any Parts aſſigned; Or to find how often one Number is contained in another; Or from any two Numbers given to find a third that ſhall conſiſt of ſo many Units, as the one of thoſe two given Numbers is comprehended or contained in the other.

2. Diviſion hath three Parts or Numbers Remarkable, *viz.* Firſt the Dividend; Secondly the Diviſor; and Thirdly the quotient. The Dividend is the Number given to be Parted or Divided. The Diviſor is the Number given, by which the Dividend is divided; Or it is the Number which ſheweth how many parts the Dividend is to be divided into. And the Quotient is the Number produced by the Diviſion of the

two given Numbers, the one by the other.

So 12 being given to be divided by 3, or into three equal parts, the Quotient will be 4, for 3 is contained in 12 four times, where 12 is the Dividend, and 3 is the Divisor, and 4 is the Quotient.

3. In Division set down your Dividend, and draw a crooked line at each end of it, and before the line at the left hand, place the Divisor, and behind that on the right hand, place the Figures of the Quotient, as in the Margent where it is required to divide 12 by 3; First I set down 12 the Dividend, and on each side of it do I draw a crooked line, and before that on the left hand do I place 3 the Divisor; then do I seek how often 3 is contained in 12, and because I find it 4 times, I put 4 behind the crooked line on the right Hand of the Dividend, denoting the Quotient.

3) 12 (4

4. But if when the Divisor is a single Figure, the Dividend consisteth of two or more places, then (having placed them for the Work as is before directed) put a point under the first Figure on the left hand of the Dividend, provided it be bigger than (or equal to) the Divisor, but if it be lesser than the Divisor, then put a point under the second Figure from the left hand of the Dividend.

vidend, which Figures as far as the point goeth from the left hand are to be reckoned by themſelves, as if they had no dependance upon the other part of the Dividend, and for diſtinction ſake may be called the Dividual, then ask how often the Diviſor is contained in the Dividual, placing the Anſwer in the Quotient; then multiply the Diviſor by the Figure that you placed in the Quotient and ſet the Product thereof under the Dividual; then draw a line under that Product, and ſubſtract the ſaid Product from the Dividual, placing the remainder under the ſaid line, then put a point under the next figure in the Dividend, on the right hand of that which you put the point before, and draw it down, placing it on the right hand of the Remainder, which you found by Subſtraction; which Remainder with the ſaid Figure annexed before it, ſhall be a new Dividual; then ſeek again how often the Diviſor is contained in this new Dividual; and put the Anſwer in the Quotient on the right hand of the Figure which you put there before, then multiply the Diviſor by the laſt Figure that you put in the Quotient and ſubſcribe the Product under the Dividual, and make Subſtraction, and to the Remainder draw down the next Figure from the grand Dividend, (having firſt

put a point under it) and put it on the right hand of the Remainder for a new dividual as before, *&c.* and proceed thus till the Work is finiſhed.

Obſerving this general Rule in all kinds of Diviſion, firſt to ſeek how often the diviſor is contained in the dividual; then (having put the anſwer in the Quotient) multiply the Diviſor thereby, and ſubſtract the Product from the dividual. An Example or two will make the Rule plain. Let it be Required to divide 2184 by 6. I diſpoſe of the Numbers given as is before directed, and as you ſee in the Margent, in order to the work; then (becauſe 6 the diviſor is more than 2 the firſt Figure of the dividend) I put a point under 1 the ſecond Figure, which makes 21 for the Dividual,

6)2184(

then do I ask how often 6 the diviſor, is contained in 21, and becauſe I cannot have it more than three times, I put 3 in the Quotient, and thereby do I multiply the diviſor (6) and the product is 18, which I ſet in order under the dividual and ſubſtract it therefrom, and the Remainder (3) I place in order under the line, as you ſee in the Margent.

```
6)2184(3
  18
  ——
   3
```

Then do I make a point under the next

Figure of the dividend being 8, and draw it down, placing it before the Remainder 3, so have I 38 for a new dividual, then do I seek how often 6 is contained in 38, and because I cannot have more than 6 times, I put 6 in the Quotient, and thereby do I multiply the divisor 6, and the product (36) I put under the dividual (38) and Substract it therefrom, and the remainder 2 I put under the line as you see in the Margent.

6) 2184 (36
18
———
38
36
———
2

Then do I put a point under the next (and last) Figure of the dividend (being 4) and draw it down to the remainder 2, and putting it on the right hand thereof it maketh 24 for a new dividual; then I seek how often 6 is contained in 24, and the Answer is 4, which I put in the quotient and multiply the divisor (6) thereby; and the product (24) I put under the dividual (24) and subtract it therefrom, and the remainder is 0, and thus the Work is finished, and I find the quotient to be 364, that is, 6 is contained in 2184 just 364 times, or 2184

6) 2184 (364
18
———
38
36
———
24
24
———
00

being divided into 6 equal parts, 364 is one of thoſe parts.

Again; if it were required to divide 2646 by 7 or into 7 equal parts, the Quotient would be found to be 378, as by the following Operation appeareth.

```
7)2646(378
   ...
  21
  --
   54
   49
   --
    56
    56
    --
    00
```

So if it were required to divide 946 by 8, the Quotient will be found to be 118 and 2 Remaining after Diviſion is ended. The Work followeth.

```
8) 946 (118
   ...
   8
   -
   14
    8
   --
    66
    64
    --
   (2)
```

Many times the dividend cannot exactly be divided by the divisor, but something will remain, as in the last Example, where 946 was given to be divided by 8, the quotient was 118 and there remaineth 2 after the division is ended; Now what is to be done in this case with the Remainder, the Learner shall be taught when we come to treat of the Reducing (or Reduction) of Fractions.

And here Note that if after your division is ended, any thing do remain, it must be lesser than your divisor, for otherwise your Work is not rightly performed.

Other Examples are such as follow.

```
8) 73464 (9183          9) 13758 (1528
   72                      9
   ---                     ---
    14                      47
     8                      45
   ----                    ----
     66                      25
     64                      18
    ---                     ---
     24                      78
     24                      72
    ---                     ---
    (0)                     (6)
```

5. But if the divisor consisteth of more places than one, then chuse so many Figures from the left side of the dividend for a dividual as there are Figures in the divisor, and put a point under the farthest Figure of that Dividual to the right Hand, and seek how often the first Figure on the left side of the Divisor, is contained in the first Figure on the left side of the dividual, and place the Answer in the Quotient, and thereby multiply your divisor, placing your product under your dividual, and substract it therefrom, placing the Remainder below the line; then put a point under the next Figure in the dividend, and draw it down to the said Remainder, and annex it on the right side thereof, which makes a new dividual, and proceed as before, till the work is finished.

And if it so happen that after you have chosen your first dividual (as is before directed) you find it to be lesser than the divisor, then put a point under a Figure more near to the right hand, and seek how often the first Figure on the left side of the divisor, is contained in the two first Figures on the left side of the dividual, and place the answer in the quotient, by which multiply the divisor and place the product thereof in order under the dividual, and substract it therefrom and proceed as before.

Always remembring, that (in all the cases of Division) if after you have multiplied your Divisor by the Figure last placed in the quotient, the product be greater than the dividual, then you must cancel that Figure in the quotient, and instead thereof put a Figure lesser by a Unit (or one) and multiply the Divisor thereby, and if still the product be greater than the dividual, make the Figure in the quotient yet lesser by a Unit, and thus do until your product be lesser than the dividual, or at the most equal thereto, and then make Substraction, *&c.*

So if you would divide 9464 by 24, the quotient will be found to be 394, I first put down the given *Numbers*, as before is directed in the third Rule: now because my divisor consisteth of two Figures, I therefore put a point under the second Figure from the left hand in my dividend, which here is 4, wherefore I seek how often 2 the first Figure (on the left side of the divisor) is contained in 9 (the like first in the Dividual) the answer is 4, which I put in the quotient, and thereby multiply all the divisor and find the product to be 96, which is greater than the dividual 94, wherefore I cancel the 4 in the

```
24)9464( 3
    .      4
   72
   ——
   22
```

quotient.

quotient,and inſtead thereof I put 8 (a unit leſſer) and by it multiply the diviſor 24, and the product is 72, which I ſubſtract from 94 the Dividual, and the Remainder is 22, then do I make a point under the next Figure 6 in the dividend, and draw it down and place it on the right ſide of the Remainder 22, and it makes 226 for a new Dividual, now becauſe the Dividual 226 conſiſteth of a Figure more than the Diviſor, therefore I ſeek how often 2 (the firſt Figure of the Diviſor is contained in 22 (the two firſt of the dividual) I ſay nine times, wherefore I put 9 in the quotient and thereby multiply the Diviſor 24, the product (216) I place under the dividual 226, and ſubſtract it from it, and there remaineth 10.

```
24) 9464 (39
      ..
    72
    ---
    226
    216
    ---
     10
```

Then I go on and make a point under the next and laſt Figure (4) in the dividend, and draw it down to the Remainder 10, and it maketh 104, for a new dividual, which is alſo a Figure more than the Diviſor, and therefore I ſeek how often two is contained in ten, I anſwer five times, but multiplying my Diviſor by five, the product is 120, which

which is greater than the Diviſor, and therefore I make it but four, and by it multiply the diviſor, and the product is 96 which being placed under, and ſubſtracted from the dividual, there remaineth 8, and thus the whole work of this diviſion is ended, and I find that 9464 being divided by 24, or into 24 equal parts, is found to be 394, as was ſaid before, and the Remainder is 8, as you ſee in the Margent.

```
24) 9464 (394
     ...
    72
    ---
    226
    216
    ---
     104
      96
     ---
     (8)
```

Another Example may be this, let there be required the quotient of 1183653 divided by 385, firſt I diſpoſe of the *Numbers* in order to their dividing, and becauſe 118 the three firſt Figures of the dividend is leſſer than the diviſor 385, I therefore make a Point under the fourth Figure, which is 3 and ſeek how often 3 (the firſt Figure of the diviſor) is contained in 11? the Anſwer is 3, which I put in the quotient, and thereby multiply the diviſor 385, and the product is 1155 which I ſubſtract from

```
385) 1183653 (3
        .
     1155
     ----
       28
```

from the Dividual 1188 and there remains 28. Then (as before) I draw down the next Figure, which is 6, and place it before the Remainder 28, so have I 286 for a new dividual, and because it hath no more Figures than the divisor, I seek how often 3 (the first Figure in the divisor) is contained in 2 (the first Figure of the dividual) and the Answer is 0, for a greater Number cannot be contained in a lesser, wherefore I put 0 in the quotient, and thereby (according to the 5*th*. Rule) I should multiply my divisor, but if I do the product will be 0, and 0 substracted from the dividual 286, the Remainder is the same; wherefore I draw down the next Figure (5) from the dividend and put it before the said Remainder 286, so have I 2865 for a new dividual and because it consisteth of four places (*viz.*) a place more than the divisor, I seek how often 3 (the first Figure of the divisor) is contained in 28 (the

```
385) 1183653 (30
        ..
     1155
     ----
      286
```

```
385) 1183653 (307
        ...
     1155
     ----
      2865
      2695
      ----
       170
```

two firſt of the dividual) and I ſay there is 9 times 3 in 28, but multiplying my whole diviſor (385) thereby I find the product to be 3465, which is greater than the dividual 2865, wherefore I chooſe eight which is leſſer by a Unit than nine, and thereby I multiply my diviſor 385, and the product is 3080, which ſtill is greater than the ſaid dividual, wherefore I chooſe another Number yet a Unit leſſer, *viz.* 7; and having multiplied my diviſor thereby, the Product is 2695, which is leſſer than the dividual 2865, wherefore I put ſeven in the quotient, and ſubſtract 2695 from the dividual 2865, and there remains 170, then I draw down the laſt Figure (3) in the dividend, and place it before the ſaid Remainder 170, and it makes 1703 for a new dividual, then (for the Reaſon aboveſaid) I ſeek how often three is contained in 17, the anſwer is 5, but multiplying the Diviſor thereby, the Product is (1925) greater than the Dividual, wherefore I ſay it will bear 4 (a Unit leſſer) and by

```
385)1183653(3074
      ....
    1155
    ----
     2865
     2695
     ----
      1703
      1540
      ----
       163
```

it I multiply the diviſor 385, and the product is 1540, which is leſſer than the dividual, and therefore I put 4 in the Quotient, and ſubſtract the ſaid Product from the dividual and there remaineth 163, and thus the Work is finiſhed, and I find that 1183653 being divided by 385, or into 385 equal ſhares, or parts, the Quotient (or one of thoſe parts) is 3074, and beſides there is 163 Remaining.

And thus the Learner being well verſed in the Method of the foregoing Examples, he may be ſufficiently qualified for the dividing of any greater Sum or Number into as many parts as he pleaſeth, that is, he may underſtand the method of dividing by a Diviſor which conſiſteth of 4, or 5, or 6, or any greater number of places, the method being the ſame with the foregoing Examples in every Reſpect.

Other

Other Examples of Division.

```
27986) 835684790 (29860
          ....
        55972
        ------
        275964
        251874
        ------
         240907
         223888
         ------
          170199
          167916
          ------
Remains  (22830)
```

```
196374) 473986018 (2413
             ....
        392748
        ------
        812380
        785496
        ------
         268841
         196374
         ------
          724678
          589122
          ------
Remains  (135556)
```

So

So if you divide 47386473 by 58736, you will find the Quotient to be 806, and 45257 will remain after the work is ended.

In like manner if you would divide 3846739204 by 483064, the quotient will be 7963 and the Remainder after Division will be 100572.

Compendiums in Division.

1. IF any given Number be to be divided by another Number that hath Cyphers annexed on the right side thereof, (omitting the Cyphers) you may cut off so many Figures from the right hand of the Dividend, as there are Cyphers before the Divisor, and let the Remaining numbers in the Dividend, be divided by the remaining number or numbers in the Divisor; observing this Caution, that if after your Division is ended any thing remain, you are to annex thereto, the *number* or *numbers* that were cut off from the *Dividend*; and such new found *number* shall be the Rem-

Et si Divisor adjunctos sibi habeat Circulos ad dextram, omissis circulis & abscissis totidem ultimis Figuris dividendi, in numeris reliquis fiat divisio, in fine autem divisionis restituendi sunt tum omissi circuli, tum figuræ abscissæ. Ought. Cla. Math. cap. 5. 3.

der, As for Example; Let it be required to divide 46658 by 400; now because there are two Cyphers before the Divisor, I cut off as many Figures from before the *Dividend*, *viz.* 58, so that then there will remain only 466 to be *divided* by 4, and the Quotient will be 116, and there will remain 2, to which I annex the two Figures (58) which were cut off from the *dividend*, and it makes 258 for the true Remainder, so that I conclude 46658 being divided by 400, the Quotient will be 116, and 258 remaineth after the Work is ended, as by the Work in the Margent.

```
4|00)466|58(116
      ..
      4
     ---
      6
      4
     ---
      26
      24
     ---
      258
```

2. And hence it followeth that if the Divisor be (1) or a Unit with Cyphers annexed, you may cut off so many figures from before the dividend, as there are Cyphers in the divisor, and then the figure or figures that are on the left hand, will be the Quotient, and those

> Divisurus quemcunque numerum per 10. Aufer ex dextra parte unicam, eamque primam figuram: Reliquæ enim figuræ productum ostendunt. ablatum Residuum, &c. Gem. Fris. Arith. part. 1.

that on the right hand will be the Remainder, after the Division is ended: as thus, if 45783 were to be divided by 10, I cut off the last figure (3) with a dash thus (4578|3) and the work is done, and the quotient is 4578 (the number on the left hand of the dash) and the Remainder is 3 (on the right hand;) in like manner if the ſame Number 45783 were to be divided by 100, I cut off 2 Figures from the end thus (457|83) and the quotient is 457, and the remainder is 83. And if I were to divide the ſame by 1000, I cut off 3 figures from the end thus (45|783) and the Quotient is 45, and 783 the Remainder, *&c.*

6. The General Effect of Diviſion is contained in the definition of the ſame (that is) by having two unequal numbers given to find a third number in ſuch Proportion to the dividend, as the diviſor hath to unit, or 1, it alſo diſcovers what reaſon or proportion there is between numbers, ſo if you divide 12 by 4 it quotes 3, which ſhews the reaſon, or proportion of 4 to 12 is triple.

The ſecond Effect is by the ſuperficial meaſure or content, and the length of any oblong, rectangular parallelogram, or ſquare Plain known, to find out the breadth thereby; or contrariwiſe by having the ſuperficies, and breadth of the ſaid Figure, to find

out

out the length thereof. Alſo by having the ſolidity and length of a ſolid, to find the ſuperficies of the baſe, *& contra.*

The third effect is, by the contents, reaſon, price, value, buying, ſelling, expences, wages, exchange, intereſt, profit, or loſs of any number of things (be it Money, Merchandize, or what elſe) to find out the contents, reaſon, price, value, buying, ſelling, expence, wages, exchange, intereſt, profit, or loſs, of any one thing of like kind.

The fourth effect is to aid, to compoſe, and to make other Rules, but principally the Rule of Proportion, called the Golden Rule, or Rule of Three, and the Reduction of Moneys, Weights and Meaſures, of one Denomination into another, by it alſo Fractions are abbreviated by finding a common meaſurer, unto the Numerator and Denominator, thereby diſcovering commenſurable numbers.

If you divide the Value of any certain quantity, by the ſame quantity, the quotient diſcovers the Rate or Value of the Integer, as if eight yards of Cloth coſt 29 ſhillings; if you divide (96) the value, or price of the given quantity, by (8) the ſame quantity, the quotient will be 128, which is the value or price of 1 of thoſe yards, *& contra.*

If you divide the Value or Price of any

unknown

unknown quantity, by the value of the Integer, it gives you in the Quotient that unknown quantity whose price is thus divided; as if 12 shillings were the value of 1 yard, I would know how many yards are worth 96 shillings: here if you divide (96) the price or value of the unknown quantity, by (12) the Rate of the Integer, or one yard, the quotient will be 8, which is the number of Yards worth 96 shillings.

Some Questions answered by Division may be these following.

Quest. 1. If 22 things cost 66 shillings, what will 1 such like thing cost? *facit* 3 shillings, for if you divide 66 by 22, the Quotient is 3 for the Answer; so if 36 yards or ells of any thing be bought or sold for 108 *l.* how much shall one yard or ell be bought or sold for? *facit* 3 *l.* for if you divide 108 *l.* by 36 yards, the Quotient will be 3 *l.* the price of the Integer.

Quest. 2. If the Expence, Charges, or Wages of 7 years amount to 868 *l.* what is the Expence, Charges, or Wages of one year? *facit* 124 *l.* for if you divide 868 (the Wages of 7 years) by 7 (the Number of years) the Quotient will be 124 *l.* for the Answer, see the Work.

(7

```
7) 868 (124
   ...
   7
  ---
   16
   14
  ---
    28
    28
   ---
   (0)
```

Quest. 3. If the content of a ſuperficial Foot be 144 Inches, and the breadth of a board be 9 Inches, how many Inches of that board in length will make ſuch a Foot? *facit* 16 Inches; for by dividing 144 (the number of ſquare Inches in a ſquare Foot,) by 9 (the Inches in the breadth of the board) the Quotient is 16 for the number of Inches in length of that board, to make a ſuperficial Foot.

```
9)144(16 Inches
   ..
   9
  ---
   54
   54
  ---
  (0)
```

Queſt. 4. If the content of an Acre of Ground be 160 ſquare Perches, and the length of a Furlong (propounded) be 80 Perches,

Perches, how many Perches will there go in breadth to make an Acre, *facit* 2 Perches, for if you divide 160 (the number of Perches in an Acre) by 80 (the length of the Furlong in Perches) the Quotient is 2 Perches; and so many in breadth of that Furlong will make an Acre.

80) 160 (2 Perches
160
———
(0)

Quest. 5. If there be 893 men to be made up into a battel, the front consists of 47 men, what *number* must there be in the File? *Facit* 19 deep in the File: For if you divide 893 (the *number* of men) by 47 (the number in Front) the Quotient will be 19 File in depth; the Work followeth.

47) 893 (19 *deep in file.*
47
———
423
423
———
(0)

Quest.

Quest. 6. There is a *Table* whoſe Superficial content is 72 feet, and the breadth of it at the end is 3 feet, now I demand what is the length of this Table? *Facit* 24 Feet long; for if you divide 72 (the content of the Table in feet) by 3 (the breadth of it) the Quotient is 24 feet for the length thereof, which was required. See the Operation as followeth.

3) 72 (24
6
———
12
12
———
(0)

The Proof of Multiplication and Diviſion.

Multiplication and *Diviſion* Interchangeably prove each other; for if you would prove a Sum in *Diviſion*, whether the Operation be right or no, Multiply the Quotient by the *Diviſor*; and if any thing Remain after the *Diviſion* was ended, add it to the Product, which Product (if your Sum was rightly *divided*) will be equal to the *Dividend*; And contrariwiſe, if you would

prove a Sum in Multiplication, *divide* the *Product* by the *Multiplier*, and if the work was rightly performed, the Quotient will be equal to the Multiplicand. See the Example where the Work is done and undone; Let 7654 be given to be multiplied by 3242, the Product will be 24814268 as by the Work appeareth.

```
    7654
    3242
    ----
   15308
  30616
 15308
22962
--------
24814268
```

And then if you *divide* the said *Product* 24814268 by 3242 the Multiplier, the Quotient will be 7654 equal to the given Multiplicand.

```
3242) 24814268 (7654
         ....
      22694
      -----
       21202
       19452
       -----
        17506
        16210
        -----
         12968
         12968
         -----
          (0)
```

In like manner (to prove a Sum or Number in *Division*) If 24814268 were *divided* by 3242 the Quotient would be found to be 7654; then for proof, if you multiply 7654 the Quotient by 3242 the *Divisor*, the Product will amount to 24814268, equal to the Dividend.

Or you may prove the last or any other Example in Multiplication thus, *viz.* *Divide* the Product by the Multiplicand, and the Quotient will be equal to the Multiplier. See the Work.

```
        7654
        3242
      ------
       15308
      30616
     15308
    22962
   ---------
7654) 24814268 (3242
   22962
   -----
    18522
    15308
    -----
     32146
     30616
     -----
      15308
      15308
      -----
       (0)
```

From whence there ariseth this Corollary, that any Operation in *Division* may be proved by *Division*; for if after your *division* is ended, you divide the *dividend* by the Quotient, the new Quotient thence arising will be equal to the *Divisor* of the first operation; for Tryal whereof let the last Example be again repeated.

```
3242) 24814268 (7654
         ....
      22694
      -----
       21202
       19452
       -----
        17506
        16210
        -----
         12968
         12968
         -----
          (0)
```

For Proof whereof divide again 24814268 by the Quotient 7654, and the Quotient hence will be equal to the first *Divisor* 3242; see the Work.

```
7654) 24814268 (3242
         ....
      22962
      -----
       18522
       15308
       -----
        32146
        30616
        -----
         15308
         15308
         -----
          (0)
```

But in proving *Division* by *Division*, the Learner is to observe this following Caution, that if after his *Division* is ended there be any remainder, before you go about to prove your work, Substract that Remainder out of your dividend, and then work as before, as in the following Example, where it is required to divide 43876 by 765, the Quotient here is 57 and the remainder is 271; See the Work following.

765) 43876 (57
3825
―――
5626
5355
―――
(271)

Now to prove this work substract the Remainder 271 out of the *Dividend* 43876 and there remaineth 43605 for a new *Dividend* to be *divided* by the former *Quotient* 57, and the *Quotient* thence arising is 765 equal to the given *Divisor*, which proveth the operation to be Right.

```
        43876
          271
       ------
57)  43605 (765
      . . .
      399
     ------
      370
      342
     ------
       285
       285
     ------
       (0)
```

Thus have we gone through the four Species of Arithmetick, *viz.* Addition, Substraction, Multiplication, and Division; upon which all the following Rules and all other Operations whatsoever that are possible to be wrought by Numbers have their immediate dependance, and by them are resolved. Therefore before the Learner make a further step in this Art, let him be well acquainted with what hath been delivered in the forgoing Chapters.

Hæ sunt igitur quatuor illæ species arithmetices per quas omnia quæcunque deinceps dicenda sunt vel quæ per numeros fieri possibile est, absolvuntur. Quare eas quisquis es ante omnia perdisces. Gem. Fris. Arith. par. 1.

CHAP. VIII.

Of Reduction.

1. REDUCTION, is that which brings together 2 or more numbers of different denominations into one denomination; or it serveth to change or alter Numbers, Mony, Weight, Measure, or Time, from one Denomination to another; and likewise to abridge Fractions to their lowest *Terms*. All which it doth so precisely, that the first *Proportion* remaineth without the least jot of *Error* or *Wrong* Committed. So that it belongeth as well to *Fractions* as *Integers*, of which in its proper place. *Reduction* is generally performed, either by Multiplication or Division; from whence we may gather, that,

Hill's Arith. Ch. 13. 152.

2. *Reduction* is either Descending or Ascending.

3. *Reduction* Descending, is when it is Required to *Reduce* a *Sum* or *Number* of a greater Denomination, into a lesser; which *Number*,

Number, when it is so *reduced*, shall be equal in value to the *number* first given in the greater Denomination; as if it were required to know how many *shillings*, *pence*, or *farthings* are equal in value to an *hundred pounds*? or how many *ounces* are contained in 45 *hundred weight*; or how many *days*, *hours*, or *minutes*, therē are in 240 *Years*, *&c.* And this kind of *Reduction* is generally performed by Multiplication.

Wing. Arith. Ch. 7. 2. 3. 4.

4. *Reduction* Ascending, is when it is Required to *Reduce* or *Bring* a *Sum* or *Number* of a smaller Denomination into a Greater, which shall be equivalent to the given *number*; as suppose it were required to find out how many Pence, Shillings, or Pounds, are equal in value to 43785 *Farthings*; or how many *Hundreds* are equal to (or in) 3748 *pounds*, &c. and this kind of *Reduction* is always performed by *Division*.

5. When any *Sum* or *Number* is given to be *Reduced* into another Denomination, you are to consider whether it ought to be Resolved by the Rule Descending or Ascending, *viz.* by Multiplication or Division; If it be to be performed by Multiplication, consider how many parts of the De-

nomination into which you would reduce it, are contained in a *Unit* or *Integer* of the given *Number*, and multiply the said given *number* thereby, and the Product thereof will be the Answer to the Question. As if, the Question were, in 38 *pounds*, how many *shillings?* here I consider, that in one *pound* are 20 *shillings*, and that the number of *shillings* in 38 *pounds* will be 20 times 38, wherefore I multiply 38 *l.* by 20, and that product is 760, and so many *shillings* are contained in 38 *pounds*, as in the Margent.

38
20
760

But when there is a Denomination, or Denominations between the *Number* given and the *Number* required, you may (if you please) reduce it into the next inferior Denomination, and then into the next lower than that, *&c.* until you have brought it into the Denomination required; As for Example, let it be demanded in 132 *pounds* how many *farthings*? First, I multiply 132 (the *Number* of *pounds* given) by 20 to bring it into *shillings*, and it makes 2640 *shillings*, then do I Multiply the *shillings* (2640) by 12, to bring them into *pence*,

132	*pounds*
20	
2640	*shill.*
12	
5280	
2640	
31680	*pence*
4	
126720	*farth.*

and

and it produceth 31680, and so many *pence* are contained in 2640 *shillings*, or 132 *pounds*; then do I multiply the *pence*, *viz.* 31680 by 4 to bring them into *farthings* (because 4 *farthings* is a *penny*) and I find the *product* thereof to be 126720, and so many *farthings* are in equal value to 132 *pounds*, the Work is manifest in the Margent.

6. And if the *number* propounded to be Reduced, is to be divided, or wrought by the Rule Ascending, consider how many of the given *numbers* are equal to an *Unit* or *Integer*, in that denomination to which you would *reduce* your given *number*, and make that your *Divisor*, and the given *Number* your *Dividend*; and the Quotient thence arising will be the *number* sought or *required*; As for Example, Let it be required to reduce 2640 *shillings* into *pounds*; here I *consider* that 20 *shillings* are equal to one *pound*, wherefore I divide 2640 (the given *number*) by 20, and the Quotient is 132, and so many *pounds* are contained in 2640 *shillings*. In Reduction descending and ascending the Learner is advised to take particular notice of the Tables delivered in the second Chapter of

```
            l
2|0)264|0(132
    ...
    2
    -
    6
    6
    -
    4
    4
    -
   (0)
```

this

this Book, where he may be informed what *Multipliers* or *Divisors* to make use of in the *reducing* of any *number* to any other denomination whatsoever, especially *English* Moneys, Weights, Measures, Time and Motion; but in this place it is not convenient to meddle with *Forreign* Coyns, Weights, or Measures.

But if in Reduction Ascending it happen that there is a denomination, or denominations between the *number* given, and the *number* required, then you may reduce your *number* given into the next *superiour* denomination, and when it is so reduced, bring it into the next above that and so on until you have brought it into the Denomination *required*. As for Example,

Let it be demanded in 126720 *farthings*, how many *pounds?* First, I divide my given *number* (being *farthings*) by 4, to bring them into *pence*, (because 4 *farthings* make one *peny*) and they are 31680 *pence*, then I divide 31680 *pence* by 12, and the Quotient giveth 2640 *shillings*, and then I divide 2640 *shillings* by 20, and the Quotient giveth 132 *pounds*, which are equal in value to 126720 *farthings*. See the whole Work as it followeth.

		12)	20)	l.
4)	125720	(31680	(264|0	(132
	......	...	..	
	12	24	2	
	6	76	6	
	4	72	6	
	27	48	4	
	24	48	4	
	32	(0)	(0)	
	32			
	(0)			

7. When the *number* given to be Reduced, consisteth of divers denominations, as *pounds*, *shillings*, *pence* and *farthings*, or of *hundreds*, *quarters*, *pounds*, and *ounces*, &c. then you are to reduce the highest (or greatest) denomination into the next *Inferiour*, and add thereunto the *number* standing in that denomination which your greatest or highest *number* is reduced to; then Reduce that *Sum* into the next *inferiour* Denomination, adding thereto the *number* standing in that denomination; do so until you have brought the *number* given into the denomination proposed. As if it were *Required* to Reduce 48 *l.* 13 *s.* 10 *d.* into *pence*; first, I bring 48 *l.* into *shillings*, by multiplying

multiplying it by 20, and the *product* is 960 *ſhillings*, to which I add the 13 *ſhillings*, and they make 973, then I multiply 973 by 12, to bring the *ſhillings* into *pence*, and they make 11676 *pence*, to which I add the 10 *pence*, and they make 11686 *pence* for the Anſwer; ſee the work done.

	l. *s.* *d.*	
	48--13--10	
	20	
	960	*ſhillings*
Add	13	
Sum	973	*ſhillings*
	12	
	1946	
	973	
	11676	*pence*
Add	10	
Sum	11686	*pence*

8. If (in Reduction Aſcending) after Diviſion is ended, any thing remain, ſuch Remainder is of the ſame Denomination with the Dividend.

Example. In 4783, I demand how many *Pounds*.

First, I divide the given *number* of *far-*

things

things (*viz*. 4783) by 4 to bring them into *pence*, and the Quotient is 1195 *pence*, and there remaineth 3 after the work of Diviſi-on is ended, which is 3 *farthings*.

Again, I divide 1195 *pence* (the ſaid Quotient) by 12, to reduce them into *ſhillings*, and the Quotient is 99 *ſhillings*, and there is a Remainder of 7, which is 7 *pence*.

And then I divide 99 *ſhillings* (the laſt Quotient) by 20 to bring it into *pounds*, and the Quotient is 4 *pound*, and there remaineth 19 *ſhillings*; ſo that I conclude that in 4783 (the propoſed *number* of *farthings*) there is 4 *pounds*, 19 *ſhillings*, 7 *pence*, 3 *farthings*, view the following Operation.

```
                  12)       2|0)
4) 4783          (1195      9|9  (4 pounds
   ....            ..
   4              108       8|
   ---            ---       --
   07              115      (19) ſhillings
    4              108
   ---            ---
   38       Rem. (7) pence
   36
   ---                    l.   s.   d.   qrs.
   23           facit     04--19--07--03
   20
   ---
Remains (3) farthings
```

More

More Examples in Reduction of Coin.

Queſt. 1. In 438 *l.* how many *ſhillings?* *Facit* 8760 *ſhillings*, for by multiplying 438 by 20, the *Product* amounteth to ſo much. See the Work.

	438 *pounds*
	20
Facit	8760 *ſhillings*

Queſt. 2. In 467 *l.* how many *Pence?* Firſt, multiply the given *number* of *pounds* (467) by 20, to bring it into *ſhillings*, and it makes 9340 *ſhillings*, then multiply the *ſhillings* by 12, and it produceth 112080 *pence*, thus,

	467 *pounds*
	20
	9340 *ſhillings*
	12
	18680
	9340
Facit	112080 *pence*

Or it may be reſolved thus, *viz.* multiply the given *number* of *pounds* (467) by (240) the *number* of *pence* in a *pound*, and the Product

Product is the same, *viz.* 112080 *pence*, as by the Operation appeareth.

	467 *pounds*
	240
	18680
	934
Facit	112080 *pence*

Quest. 3. In 5673 *l.* how many *farthings*? First, Multiply the given *number* by 20, to bring it into *shillings*, and it produceth 113460 *shillings*, then multiply that *product* by 12, to bring it into *pence*, and it produceth 1361520 *pence*; then lastly, multiply the *pence* by 4, and it produceth 5446080 *farthings*. See the Operation,

	5673 *pounds*
	20
	113460 *shilling*
	12
	226920
	113460
	1361520 *pence*
	4
Facit	5446080 *farthings*

Or

Or this Queſtion might have been thus reſolved, *viz.* Multiply 5673 (the given *number* of *pounds*) by 960 (the *number* of *farthings* in a *pound*) and it produceth the ſame Effect, as you may ſee by the Work.

```
          5673  pounds              20  ſhillings
           960                      12
       -------                   -------
        340380                     240  pence
        51057                        4
       -------                   -------
Facit  5446080  farthings          960  farthings
```

Otherwiſe thus; Firſt, bring the given *number* 5673 *l.* into *ſhillings* and multiply the *ſhillings* by 48, the *number* of *farthings* in a *ſhilling*, and the ſame Effect is thereby likewiſe produced, *viz.*

```
          5673  pounds           12  pence
            20                    4
       -------                 ----
        113460  ſhillings        48  farth.
            48
       -------
        907680
       453840
       -------
Facit  5446080  farthings
```

These various ways of Operating are expreſſed to inform the Judgment of the Learner,

ner, with the Reaſon of the Rule; more ways may be ſhewn, but theſe are ſufficient even for the meaneſt Capacities.

Queſt. 4. In 458 *l.* 16 *s.* 07 *d.* 3 *qrs.* how many *farthings*? To Reſolve this Queſtion conſider the ſeventh Rule of this Chapter, and work as you are there directed, and you will find the aforeſaid given *number* to amount to 440479 *farthings, viz.*

	l.	s.	d.	qrs.
	458	16	07	3
	20			

9160 *ſhillings*
Add 16

Sum 9176 *ſhillings*
12

18352
9176

110112 *pence*
Add 07

Sum 11019 *pence*
4

440476 *farthings*
Add 3

Sum 440479 *farthings*

This

This laſt Queſtion (or any other of th[is] kind, *viz.* where the *number* given to b[e] reduced conſiſteth of ſeveral Denominati[ti]ons) may be more conciſely reſolved thus *viz.* when you multiply the pounds by 20, to bring them into ſhillings, to the *product* of the firſt *Figure*, add the *Figure* ſtanding in the place of Units in the Denomination of ſhillings, but becauſe the firſt *Figure* in the *Multiplier* is (0) I ſay 0 times 8 is nothing, but 6 is 6, which I put down for the firſt *Figure* in the *product*, then becauſe this *Multiplier* is 0, I go on no further with it, for if I ſhould, the whole *Product* would be 0, but proceed, and when I come to multiply by the ſecond *Figure* in the *Multiplier*, and to the *Product* of it, I add the *Figure* ſtanding in the place of Tens in the Denomination of ſhillings, which is (1) ſaying 2 times 8 is 16, and (the ſaid *Figure*) 1 is 17, then I ſet down 7, and carry a Unit to the *Product* of the next *Figure*, as is directed in the fifth Rule of the ſixth Chapter foregoing; and finiſh the Work. So that you now have the whole *Product* and *Sum* of *ſhillings* at one operation, which is the ſame as before, and when you multiply the ſhillings by 12, to bring them into pence, (after the ſame manner) add to the *Product*, the *number* ſtanding in the denomination of pence, and ſo when you multi-

ply the pence by four to bring them into farthings, add to the *Product* the *number* ſtanding under the Denomination of Farthings. See the laſt Queſtion thus wrought.

	l.	s.	d.	qrs.
	458--16--07--3			
	20			
	9176 *ſhillings*			
	12			
	18359			
	9176			
	110119 *pence*			
	4			
Facit	440479 *farthings*			

After the Method laſt preſcribed (which if Rightly conſidered, differeth not any thing from the *7th.* Rule of this Chapter) are all the following Examples that are of the ſame nature wrought and reſolved.

Queſt. 5. In 4375866 Farthings, I demand how many Pounds, Shillings, Pence, and Farthings?

To reſolve this Queſtion; Firſt, I divide the given *number* of Farthings by 4, and the Quotient is 1093966 Pence, and there Remaineth 2 after the Diviſion is ended, which

which(by the eighth Rule foregoing)is two Farthings; then I divide 1093966 Pence by 12, and the Quotient is 91163 Shillings, and there remaineth 10 after Division, which by the said eighth Rule is so many Pence, *viz.* 10 *d.* then I divide 91163 Shillings by 20, and the Quotient is 4558 *l.* and there remaineth 3 Shillings; so the work is finish-ed, and I find that in 4375866 Farthings there are 4558 *l.* 03 *s.* 10 *d.* 2 *qrs.* See the Operation.

```
                    12)         2|0        l.
4) 4375866  (1093966  (9116|3  (4558
   .......       .....      ....

     4            108          8
   -----        -----       -----
     37            13         11
     36            12         10
   -----        -----       -----
     15            19         11
     12            12         10
   -----        -----       -----
     38            76         16
     36            72         16
   -----        -----       -----
     26            46       (03) shillings
     24            36
   -----        -----
     26         (10) pence
     24
   -----
   (2) farthings

       l.      s.     d.    qrs.
Facit 4558----03-----10-----2
```

Quest.

Quest. 6. In 4386 *l.* I demand how many Groats?

To Resolve this Question, I reduce the given *number* of Pounds into Shillings, and they are 87720 Shillings; now I consider that in a Shilling are 3 Groats, therefore I multiply the Shillings by 3, and it produceth 263160 Groats. See the Work.

	4386	*pounds*
	20	
	87720	*shillings*
	3	
Facit	263160	*groats*

This Question might have been otherways resolved thus, *viz.* considering that in a Pound (or 20 Shillings) there are three times 20 Groats, which makes 60, by which [illegible]ly the *number* of Pounds given, and it produceth the same Effect at one Operation, as followeth.

	4386	*pounds*	20
	60	*groats in* 20 *s.*	3
Facit	263160	*groats in* 4386 *l.*	60

Queſt. 7. In 43758 three Pences, I deſire to know how many Pounds?

To reſolve this (and many ſuch like) Queſtion; Firſt, I divide my given *number* of 3 Pences by 4, becauſe 4 three Pences are in a Shilling, and the Quotient is 10939 ſhillings; and there remaineth 2 after Diviſion is ended, which is 2 three Pences (by the eighth Rule of this Chapter) which are equal in value to 6 *d.* then I divided 10939 Shillings by 20, and the quote giveth 546 *l.* and 19 *s.* Remain; ſo that I conclude in 43758 pieces of three pence *per* piece, there are 546 *l.* 19 *s.* 06 *d.* as by the work appeareth.

```
                 2|0         l.  s.  d.
4)  43758     (1093|9    (546--19--06
    4          10
    --         --
    37          9
    36          8
    --         --
     15        13
     12        12
     --        --
      38       19 shillings
      36
      --
    (2) three pences, or 6 d.
```

This Queſtion might have been otherwiſe Reſolved

Resolved thus, *viz.* first multiply the given *Number* of three pences 43758, by 3 the *Number* of pence in three pence, and the product (*viz.* 131274) is the *Number* of pence equal to the given *number* of three pences, which *number* of pence may be brought into pounds by dividing by 12 and by 20, and the quotient you will find to be equal to the former work, *viz.* 546 *l.* 19 *s.* 06 *d.*

```
         43758
             3
       ---------  2|0)        l.     s.     d.
  12)  131274   (1093|9   (546----19-----06
       .....     ...
        12        10
       ----      ----
        112        9
        108        8
       ----      ----
         47       13
         36       12
       ----      ----
        114 rem.(19) shillings
        108
       ----
Remains (6) pence
```

Or thus, divide the given *Number* of 3 pences by the *number* of 3 pences in a pound or 20 shillings (which you will find to be 80, if you multiply 20 *s.* by 4, the *number* of three pences in a shilling) and you will find the

quote to be 546 *l.* as before, and a Remainder of 78 three pences, and if you divide thoſe 78 three pences by 4, (becauſe there are 4 three pences in a ſhilling) you will find the quote to be 19 *s.* and 2 three pences Remain, which are equal to 6 *d.* which is the ſame that was before found.

```
                    l.   s.  d.
8|0) 4375|8 (546--19--06              20
     ...                                4
                                      ---
     40                               80
     ---
      37
      32
     ---
       55
       48
     ----- s.
     4) 78 (19
        ..
        4
       ---
        38
        36
       ---
        2 three pences, or 6 d.
```

Queſt. 8. In 4785 *l.* 13 *s.* how many pieces of $13\frac{1}{2}$ *d. per* piece?

This Quæſtion cannot be reſolved by Reduction, deſcending, or aſcending, abſolutely, (becauſe $13\frac{1}{2}$ *d.* is no even part of a pound (but rather by them both joyntly, *viz.* by Multiplication and Diviſion; for if you bring

bring the number given into half pence, and divide the half pence, by the half pence in 13½ *d. viz.* 27, the quotient will be the answer; for having brought 4785 *l.* 13 *s.* into half pence, I find it makes 2297112, which I divide by 27, (because there are so many half-pence in 13½ *d.*) and the quote gives 85078 pieces of 13 *d.* ½, and 6 half-pence remain over and above: observe the work following.

```
 l.    s.                      d.
 4785--13                      13½
   20                           2
 ------                       ----
 95713 shillings                27 half pence
    24 half-pence in a shilling
 ------
 382852
191426
-------
2297112 half-pence in the given number.
                                        d.
 27) 2297112 (85078 pieces of 13½
       216
       ---
        137
        135
        ---
         211
         189
         ---
          222
          216
          ---
Remains  (6) half-pence.
```

It would have produced the same answer if you had reduced your given Number into farthings, and divided by the farthings in 13½ *d. viz.* 54, (for always the Dividend and the Divisor must be of one Denomination), and then you would have had a Remainder of 12 farthings, which are equal in value to the former Remainder of 6 half-pence, as you may prove at your leisure.

Quest. 9. In 540 Dollars at 4 *s.* 4 *d. per* Dollar, how many pounds *sterling?*

First, Bring your given number of Dollars into Pence, and then your pence into Pounds according to the former directions. Thus in 4 *s.* 4 *d.* (*viz.* a dollar) you will find 52 pence, by which multiply 540 dollars, and it produceth 28080 pence, which if you divide by 240 (the pence in one pound) the quotient will give you 117 *l.* which are equal in value to 540 dollars, at 4 *s.* 4 *d. per* dollar; observe the operation.

540

```
                       s.  d.
     540               4—4
      52               12
    ----              ----
    1080              52 pence
   2700
   -----         l.
24|0) 2808|0  (117
      ...
    24
    --
    40
    24
    --
    168
    168
    ---
    (0)
```

The foregoing Queſtion might have been otherwiſe wrought, thus, *viz.* Multiply (540) your given number of dollars, by 13 the number of groats in a dollar (or 4 *s.* 4 *d*) and it produceth 7020 groats, which divide by 60 (the groats in one pound or twenty ſhillings) and the quote is 117 *l.* as before. See the work.

```
                 s.   d.
      540        4——4
       13        3
     ————       ————
     1620       13
     540
     ————
6|0) 702|0 (117
     6
     ————
     10
     6
     ————
     42
     42
     ————
     (0)
```

Quest. 10. In 547386 pieces of 4½ *d.* *per* piece, I demand how many Pounds, Shillings, and Pence?

First, Bring your given number of four pence-half-penies all into half-pence, which you will do if you multiply by 9 the number of half-pence in 4½ *d.* and the product is 4926474 half-pence, which are brought into pounds, if you divide them by 24 (the half-pence in a shilling) and 20 (the shillings) in a pound, it makes 10263 *l.* 09 *s.* 9 *d.* as by the Work.

```
                                        d.
                                        4½
      547386                            2
           9                           ---
      ---------- 2|0)   l.              9  half-pence
24) 4926474(20526|9(10263
    ......  ..:..
    48          2
    ---        ---
    126         05
    120          4
    ---        ---
     64         12                l.     s.    d.
     48         12  facit    10263--09---09
    ---        ---
    167          6
    144          6
    ---        ---
    234 rem.(09) shillings
    216
    ---
Rem. (18) half-pence or 9 d.
```

Quest. 11. In 4386 *l.* I demand how many pieces of 6 *d.* of 4 *d.* and of 2 *d.* of each an equal Number? that is to say, what Number of Six pences, Groats, and two pences, will make up 4386 *l.* and the Number of each equal?

The way to resolve questions of this nature, is, to add the several pieces (into which the given Number is to be brought) into one Sum, and to reduce the given Number

into the ſame *denomination* with their Sum, and to divide the ſaid given Number (ſo Reduced) by the ſaid Sum, and the Quotient will give you the exact number of each piece. And after the ſame Method will we proceed to Reſolve the preſent Queſtion, *viz.*

```
      l.                                d.
    4386                                 6
     240 pence                           4
  -------                                2
  175440                               ----
  8772                            Sum 12 pence
  -------
12) 1052640 (87720
    .....
      ---
    96
    --
     92
     84
     --                           d.  d.  d.
      86 facit 87720 pieces of    6--4--2
      84
      --
       24
       24
       --
       (0)
```

So that I conclude by the operation that 87720 ſix pences, and 87720 groats, and 87720 two pences are juſt as much as (or equal to) 4386 *l.* or if you admit of 5 *s.* to be

be thus divided, it is equal to 5 six pences, and 5 four pences or Groats, and 5 two pences. *For if two Right lines (or two Numbers) be given, and one of them be divided into as many Parts, or Segments as you please, the Rectangle (or Product) comprehended under the two whole Right lines (or Numbers given) shall be equal to all the Rectangles (or Products) contained under the whole line (or Number) and the several Segments (or Parts) into which the other line (or Number) is divided*, Eucl. 2. 1.

Another Question of the same Nature with the last may be this following, *viz.*

Quest. 12. A Merchant is desirous to Change 148 *l.* into pieces of 13 *d* ½, of 12 *d.* of 9 *d.* of 6 *d.* and of 4 *d.*; and he will have of each sort an equal Number of pieces, I desire to know the number?

Do as you were taught in the last question, *viz.* add the several pieces together, and reduce the Sum into half-pence, then reduce the Sum to be changed, *viz.* 148 *l.* into the same denomination, and divide the greater by the lesser, and in the Quotient you will find the Answer, *viz.* 798 is the Number of each of the pieces required, and 18 remaineth, which is 18 half-pence by the eighth Rule of this Chapter. See the work as followeth.

l.		d.
148		$13\frac{1}{2}$
240 *pence in a l.*		12
		9
5920		6
296		4
35520 *pence in* 148 l.	*Sum*	44
2		$2\frac{1}{2}$
71040 *half-pence*		89 *half-pence*

89) 71040 (798 *pieces of each sort*

623

874

801

730

712

Remains (18) *half pence.*

The truth of the two foregoing Operations will thus be proved, *viz.* multiply the Anſwer by the parts, or pieces into which the given Number was reduced, and having added the ſeveral Products together, if their Sum be equal to the given Number, the Anſwer is Right, otherwiſe not.

So the Anſwer to the 11 Queſtion was 87720, which is proved as followeth, *viz.*

87720

			l.
87720	*Six-pences*	*make*	2193
	Four-pences	*make*	1462
	Two pences	*make*	731
	The total Sum of them		4386

The total Sum of them 4386 *which was the Sum given to be Changed.*

The Anſwer to the 12*th.* Queſtion was 798, and 18 half pence remained after the work was ended, now the truth of the work may be proved as the former was, *viz.*

		d.		l.	s.	d.
798	*Pieces of*	13½	*make*	44	17	09
	Pieces of	12	*make*	39	18	00
	Pieces of	9	*make*	29	18	06
	Pieces of	6	*make*	19	19	00
	Pieces of	4	*make*	13	06	00
and 18 *half-pence, or* 9 d. *rem.*				00	00	09
The total Sum of them				148	00	00

which Total Sum is equal to the Number that was firſt given to be changed, and therefore the Operation was rightly performed.

Reduction of Troy Weight.

We come now to give the Learner some Examples in *Troy weight*, wherein we ſhall be brief, having given ſo large a Taſte of *Reduction* in the foregoing Examples of Coyn, and now the Learner muſt be mindful of the Table of *Troy weight* delivered in the ſecond Chapter of this Book.

Queſt. 13. In 482 *l.* 07 *oz.* 13 *p.w.* 21 *gr.* how many Grains?

Multiply by 12, by 20, and by 24, takeing in the Figures ſtanding in the ſeveral denominations, according to the Direction given in the 7*th.* Rule of this Chapter, and you will find the Product to be 2780013 Grains, which is the Number required, or Anſwer to the Queſtion. See the whole work as followeth.

```
l.    oz.   p.w.  gr.
482—07—13—21
 12
———
 971
482
———
5791 ounces
  20
———
115833 peny weight
    24
———
 463333
231668
———
```

Facit 2780013 *grains*

Quest. 14. In 2780013 *grains*, I demand how many Pounds, Ounces, Peny Weights, and Grains?

This is but the foregoing Question inverted, and is resolved by dividing 24 by 20, and by 12, and the Answer is 482 *l*. 07 *oz*. 13 *p.w*. 21 *gr*.

```
                2|0)        12)       l.
24) 2780013  (115833|3  (5791   (482
    .......    ....       ...
    24         10         48
    ----       ----       ----
    38         15         99
    24         14         96
    ----       ----       ----
    140        18         31
    120        18         24
    ----       ----       ----
     200        3  Rem  (7) ounces
     192        2
     ----      ----
       81  Rem (13) peny weight
       72
       ----
       93                  l.   oz.  p.w.  gr.
       72           facit 482---07----15---21
       ----
Remains  (21) grains
```

Quest. 15. A Merchant sent to a Goldsmith 16 Ingots of Silver, each containing in weight 2 *l.* 4 *oz.* and ordered it to be made into Bowls of 2 *l.* 8 *oz. per* Bowl, and Tankards of 1 *l.* 6 *oz. per* piece, and Salts of 10 *oz.* 10 *p.w. per* Salt, and Spoons of 1 *oz.* 18 *p.w. per* Spoon; and of each an equal number, I desire to know how many of each sort he must make?

This Question is of the same Nature with the 11 and 12 Questions foregoing and may be

be anſwered after the ſame method, *viz.* Firſt, add the weight of the ſeveral Veſſels (into which the Silver is to be made) into one Sum, and reduce it to one denomination, and they make 1248 *peny weights*, then reduce the weight of the Ingot into the ſame *denomination*, viz. *peny weights*, (and it makes 560 *peny weights*) and multiply them by the Number of Ingots, *viz.* 16, and the product will give you the weight of the 16 Ingots, *viz.* 8960, then divide this Product by the weight of the Veſſels, *viz.* 1248, and the Quotient giveth you the Anſwer to the Queſtion, *viz* 7. and 224 *p. w.* remaining over and above.

l.	*oz.*
2	4
12	
28	
20	
560	*peny weights*
16	*Ingots*
3360	
560	
1248) 8960	(7 *veſſels of each*
8736	
Rem. (224)	*peny weights.*

	l.	*oz.*	*p.w.*
	2	08	00
	1	06	00
	0	10	10
	0	01	18
Sum	5	02	08
	12		
	62		
	20		
	1248 *p. weights*		

The

The Proof of the work is as followeth, viz.

				l. oz. p.w.
7	*Bowls of*	2—08—00	*per bowl is*	18--08--00
	Tank. of	1—06—00	*per tank is*	10--06--00
	Salts of	0—10—10	*per salt is*	06--01--10
	Spoons of	0—01—18	*per spoon is*	01--01--06
	224 *peny weight remaining is*			00--11--04
			Total Sum	37--04--00

So that you see the Sum of the Weights of each Vessel, together with the Remainder is 37 *l.* 04 *oz.* which is equal to the Weight of the 16 Ingots delivered. For if 37 *l.* 04 *oz.* be reduced to Peny weights, it makes 8960.

Reduction of Averdupois Weight.

In Reducing *Averdupois weight*, the Learner must have Recourse to the Table of *Averdupois weight* delivered in the *M.* Chapter foregoing.

Quest. 16. In 47 *C.* 1 *qr.* 20 *l.* how many Ounces?

Multiply by 4, by 28, and by 16, and the last Product will be the Anwser, *viz.* 84992 Ounces.

C. qrs. l.
47—1—20
4

189 *quarters*
28

1512
380

5312 *l.*
16

31872
5312

Facit 84992 *ounces.*

Queſt: 17. In 84992 Ounces, I demand how many *C. qrs. l.* and *oz.*

This is the foregoing Queſtion Inverted, and will be Reſolved if you divide by 16, by 28, and by 4, and the Anſwer is 47 *C.* 1 *qrs.* 20 *l.* equal to the given Number in the foregoing Queſtion.

```
                 28)        4)     C. qrs. l. oz.
16) 84992    (5312     (189   (47--1--20-00
     ....     ...
     80        28       16
     --       ---       --
     49       251       29
     48       224       28.
     --       ---       --
      19      272      (1) quarter
      16      252
      --      ---
      32     (20) pounds
      32
      --
     (0)
```

Quest. 18. A Chapman buyeth of a Grocer 4 *C.* 1 *qrs.* 14 *l.* of Pepper, and ordered it to be made up into Parcels of 14 *l.* of 12 *l.* of 8 *l.* of 6 *l.* and of 2 *l.* and of each parcel an equal number, now. I would know the number of each parcel.

This Example is of the ſame nature with the 11, and 12, and 15 Queſtions foregoing, and after the ſame manner is reſolved. See the Operation as followeth.

C.	qrs.	l.	l.
4	1	14	14
4			12
			8
17			6
28			2
140			42 *pounds*
35			

42) 490 (11
42
70 *Facit* 11 *parcels of each*
42
Rem. (28) *pounds*

Reduction of Liquid Measures.

Quest. 19. In 45 *Tun* of Wine, how many *Gallons*?

Multiply by 4, and by 63, the product is 11340 Gallons for the Answer.

45
4
180
63
540
1080
Facit 11340 *gallons.*

Quest. 20.

Quest. 20. In 34 Rundlets of Wine each containing 18 Gallons, I demand how many Hogsheads?

First, Find how many Gallons is in the 34 Rundlets, which you may do if you multiply 34 by 18 the content of a Rundlet, and the Product is 612 Gallons, which you may reduce into Hogsheads if you divide them by 63, and the Quote will be 9 Hogsheads, and 45 Gallons. See the Work.

$$\begin{array}{r} 34 \\ 18 \\ \hline 272 \\ 34 \\ \hline \end{array}$$

63) 612 (9 *Hhds.*

$$\begin{array}{r} 567 \\ \hline \end{array}$$

Remains (45) *gallons*

facit 9 *Hhds.* 45 *gallons.*

Quest. 21. In 12 Tun, how many Rundlets of 14 Gallons *per* Rundlet?

Reduce your Tuns into Gallons, and divide them by 14, the Gallons in a Rundlet, and the Quotient (216) is your Answer. See the Work following.

```
        12
         4
       ———
        48
        63
      ————
       144
      288
    ——————
14) 3024 (216 rundl.
    ...
    28
   ————
     22
     14
    ————
      84
      84
     ———
    (0)  facit 216 rundl.
```

Reduction of Long Measure.

Quest. 22. I demand how many Furlongs, Poles, Inches, and Barley Corns will Reach from *London* to *York*, it being accounted 151 Miles?

	151	*miles*
	8	*furlongs in a mile*
	1208	*furlongs*
	40	*poles in a furlong*
	48320	*poles*
	11	*half yards in a pole*
	48320	
	48320	
	531520	*halfyards*
	18	*inches in half a yard*
	4252160	
	531520	
	9567360	*Inches*
	3	*barly corns in an inch*
Facit	28702080	*barly corns in 151 miles.*

Quest. 23. The Circumference of the Earth (as all other Circles are) is divided into 360 Degrees, and each Degree into 60 Minutes, which (upon the Superficies of the Earth) are equal to 60 miles; now I demand how many Miles, Furlongs, Perches, Yards, Feet, and Barly Corns will reach round the Globe of the Earth?

360	*degrees*
60	*minutes or miles in a degree*
21600	*miles about the Earth*
8	*furlongs in a mile*
172800	*furlongs about the Earth*
40	*perches in a furlong*
6912000	*poles or perches about the Earth*
11	*half-yards in a perch*
6912000	
6912000	
2) 76032000	*half-yards about the Earth*
(38016000	*yards, viz. the half-yards*
3	*divided by 2.*
114048000	*feet about the Earth*
12	*inches in a foot*
228096000	
114048000	
1368576000	*inches about the Earth*
3	*barly-corns in an inch*
Facit 4105728000	*barly-corns*

And ſo many will reach round the World, the whole being 21600 Miles, ſo that if any Perſon were to go Round, and go 15 Miles every Day, he would go the whole Circumference in 1440 Days, which is 3 Years, 11 Months, and 15 Days.

Reduction of Time.

Quest. 24. In 28 *years*, 24 *weeks*, 4 *days*, 16 *hours*, 30 *minutes*, how many Minutes?

years	*weeks*	*days*	*hours*	*min.*
28	24	4	16	30

```
   28
   52  Weeks in a year
  ----
   60
  142
 -----
 1489  Weeks
    7
 -----
10364  Days
   24
 ------
 41462
20729
 ------
248752  Hours
    60
14925150  Minutes
```

Note, that in Resolving the last Question after the Method expressed, there is lost in every year 30 Hours, for the year consisteth of 365 Days and 6 Hours, but by multiplying the Years by 52 Weeks, which is but 364 Days; You lose 1 Day and 6 Hours every Year, wherefore to find an exact Answer, bring the odd Weeks, Days, and Hours into Hours, and then multiply the

Year

Years by the Number of Hours in a Year, *viz.* 8766, and to the Product add the Hours contained in the odd time, and you have the exact time in hours, which bring into Minutes as before. See the laſt Queſtion thus reſolved.

weeks days hours
24---4---16
7
172
24
694
345
4144 *hours*

days hours
365--6
24
1466
730
8766 *hours in a year*

28
8766
172
172
197
228
249592 *hours*
60
14975520 *Minutes in* 28 *years and* 4144 *hours.*

So you ſee that according to the method firſt uſed to reſolve this Queſtion, the hours contained in the given time are 248752, but according to the laſt, beſt, or true method, they are 249592 which exceeds the former by 840 hours.

But for moſt occaſions it will be ſufficient to multiply the given years by 365, and to the Product add the days in the odd time, if

there be any, and then there will be only a loss of 6 hours in every year, which may be supplied by taking a fourth part of the given years, and adding it to the contained days, and you have your desire.

Quest. 25. In 438657540 Minutes, how many years? *Facit* 834 *years*, 4 *dayes*, 19 *hours.*

```
                      8766)     years  days  hours
6|0) 43865754|0  (7310959   (834----4------19

      42             70128
     ----           -------
      18             29815
      18             26298
     ----           -------
       6              35179
       6              35064
     ----           ------- days
      57         24)  115 (4
      54
     ----              96
      35              ----
      30       Rem.   (19) hours
     ----
       54
       54
      ----
      (0)
```

Quest. 26. I desire to know how many hours and minutes it is since the Birth of our Saviour Jesus Christ, to this present year being accounted 1677 years?

The

This Queſtion is of the ſame nature with the 24*th*. foregoing, and after the ſame manner is Reſolved, *viz.* Multiply the given number of years by 8766, the Product is 14700582 hours, and that by 60, and the Product is 882034920 Minutes. See the work.

1677	*years*
8766	*hours in a year*
10062	
10062	
11739	
13416	
14700582	*hours in* 1677 *years*
60	
882034920	*minutes in* 1677 *years.*

Note that as Multiplication and Diviſion do interchangeably prove each other, ſo Reduction Deſcending, and Aſcending, prove each other by Inverting the Queſtion, as the 13 and 14, and likewiſe the 16 and 17 Queſtions foregoing, by Inverſion, do interchangeably prove each other, the like may be performed for the proof of any Queſtion in Reduction whatſoever.

Thus far have we discoursed concerning single Arithmetick, whose Nature and Parts are defined in the second, eighth, ninth, and tenth definitions of the third Chapter of this Book, for although Reduction is not reckoned or defined among the Parts of single Arithmetick, yet considered Abstractly, it is the proper effect of Multiplication and Division; and as for the extraction of Roots (which ought to be handled in the next place as parts of single Arithmetick) we shall omit it in this place, and refer the Learner to Mr. *Cocker*'s decimal Arithmetick, which is (with great care and pains) now published together with his Logarithmetical Arithmetick, shewing the Genesis or Fabrick of the Logarithms, and their general uses in Arithmetick, *&c.* As also his Algebraical Arithmetick, containing the Doctrine of Composing and resolving an Equation, with all other Rules necessary for the understanding of that Mysterious Art, *&c.*

CHAP.

CHAP. IX.

Of Comparative Arithmetick, viz. The Relation of *Numbers* one to another.

1. COmparative Arithmetick is that which is wrought by Numbers, as they are considered to have Relation one to another, and this consists either in Quantity, or in Quality.

Boëtius Arith. lib. 1. *cap.* 21.

2. Relation of Numbers in Quantity, is the Reference or Respect, that the Numbers themselves have one to another, where the Terms or Numbers propounded are always two, the first called the Antecedent, and the other the Consequent.

Vide Wing. Arith. cap. 34.

3. The Relation of Numbers in Quantity, consists in the Differences, or in the Rate or Reason that is found betwixt the Terms propounded the Difference of two

Numbers, being the Remainder found by Subſtraction, but the Rate or Reaſon betwixt two Numbers is the Quotient of the Antecedent divided by the Conſequent. So 21 and 7 being given the difference betwixt them will be found to be 14, but the Rate or Reaſon that is betwixt 21 and 7 will be found to be Triple Reaſon, for 21 divided by 7 quotes 3, the reaſon or rate.

Alſted. Mathemat. lib.2. cap.11. & 12.

4. The Relation of Numbers in Quality, (otherwiſe called Proportion) is the Reference or Reſpect that the Reaſon of Numbers have one unto another; therefore the Terms given, ought to be more than two.

Now this Proportion or Reaſon between numbers relating one to another, is either Arithmetical or Geometrical.

Alſted. Math. lib.2.cap.21.

5. Arithmetical Proportion (by ſome called Progreſſion) is when divers Numbers differ one from another by equal Reaſon, that is, have equal Differences.

So this Rank of Numbers, 3, 5, 7, 9, 11, 13, 15, 17, differ by equal Reaſon, *viz.* by 2, as you may prove.

6. In a Rank of Numbers that differ by Arithmetical Proportion, the Sum of the firſt and laſt term, being multiplied by half the Number of Terms, the Product is the Total

total Sum of all the Terms.

Or if you multiply the Number of the Terms by the half Sum of the firſt and laſt Terms, the Product thereof will be the Total Sum of all the Terms.

So in the former Progreſſion given, 3 and 17 is 20, which Multiplied by 4 (*viz.* half the Number of Terms) the Product gives 80, The Sum of all the Terms; or multiply 8, (the Number of Terms) by 10 (half the Sum of the firſt and laſt Terms) the Product gives 80 as before.

So alſo 21, 18, 15, 12, 9, 6, 3, being given, the Sum of all the Terms will be found to be 84; for here the Number of Terms is 7, and the Sum of the firſt and laſt (*viz.* 21 and 3) is 24, half whereof (*viz.* 12) multiplied by 7 produceth 84, the Sum of the Terms ſought.

7. Three *Numbers* that differ by Arithmetical *Proportion*, the double of the mean (or middle *number*) is equal to the Sum of the *Extreams*.

So 9, 12, and 15, being given the double of the mean 12 (*viz.* 24) is equal to the Sum of the *Extreams*, 9 and 15.

8. Four *Numbers* that differ by Arithmetical Proportion (either continued or interrupted) the Sum of the two *Means* is equal to the Sum of the two *Extreams*.

Vide Wing. Arithm. cap. 35.

So 9, 12, 18, 21, being given, the Sum of 12 and 18 will be equal to the Sum of 9 and 21, *viz.* 30; alſo 6, 8, 14, 16, being given, the Sum of 8 and 14, is equal to the Sum of 6 and 16, *viz.* 22, *&c.*

9. Geometrical Proportion (by ſome called Geometrical Progreſſion) is when divers *numbers* differ according to like Reaſon.

So 1, 2, 4, 8, 16, 32, 64, *&c.* differ by double Reaſon, and 3, 9, 27, 81, 243, 729, differ by Triple Reaſon, 4, 16, 64, 256, *&c.* differ by Quadruple Reaſon, *&c.*

10. In any *numbers* that increaſe by Geometrical proportion, if you multiply the laſt Term by the Quotient of any one of the *terms*, divided by another of the *terms*, which being leſs is next unto it, and having deducted, or ſubſtracted, the firſt Term out of that Product, divide the Remainder by a *number* that is an unit leſs than the ſaid Quotient, the laſt quote will give you the Sum of all the Terms.

64
4) 8 (2
128
1
1) 127 (127

So 1, 2, 4, 8, 16, 32, 64, being given, firſt, I take one of the *terms*, *viz.* 8, and divide it by the *term* which is leſs and next to it, (*viz.* by 4) and the Quotient is 2, by which

which I multiply the laſt *term* 64, and the Product is 128, from whence I ſubſtract the firſt *term* (*viz.* 1.) the Remainder is 127, which divided by the Quotient 2 made leſs by 1 (*viz.* 1) the quote is 127, for the Sum of all the given *terms*, as by the Work in the Margent.

So if 4, 16, 64, 256, 1024, were given, the Sum of all the *terms* will be found to be 1364. For firſt, I divide 64 one of the *terms* by his next leſſer *term*, and the Quotient is 4, by which I multiply the laſt *term* 1024, and it produceth 4096; from whence I ſubſtract the firſt *term* 4, and the Remainder is 4092, which I divide by the quote leſs 1 (*viz.* 3) and the quote is 1364, for the total Sum of all the *terms*, as *per* Margent.

```
      1024
16)64(   4
   ------
      4096
         4
   ------
3) 4092(1364
```

So likewiſe if 2, 6, 18, 54, 162, 486, were given the Sum or total of all the *terms* will be found to be 728. See the work.

```
      486
6)18(   3
   -----
     1458
        2
   -----
2) 1456(728
```

11. Three Geometrical Proportionals given, the Square of the Mean is equal to the Rectangle, or Product of the *Extreams*.

So 8, 16, 32, being given, the Square of the Mean, *viz.* 16 is 256, which is equal to the Product of the *Extreams* 8 and 32, for 8 times 32 is equal to 256.

12. Of 4 Geometrical Proportional *numbers* given the Product of the two Means is equal to the Product of the two *Extreams.*

So 8, 16, 32, 64, being given, I say that the Product of the two Means, *viz.* 16 times 32 which is 512 is equal to 8 times 64, the Product of the *Extreams.*

Also if 3, 9, 21, 69, were given (which are Interrupted) I say 9 times 21 is equal to 3 times 63, which is equal to 189.

From hence ariseth (that precious Gem in Arithmetick, which for the excellency thereof is called the Golden Rule, or Rule of 3.

CHAP. X.

The Single Rule of Three Direct.

1. THE Rule of Three (not undeservedly called the Golden Rule) is, that by which we find out a fourth *number*, in *proportion*

portion unto *three* given *Numbers*, so as this *fourth number* sought may bear the same Rate, Reason, or Proportion to the *third* (given) *number*, as the second doth to the first, from whence it is also called the Rule of *Proportion*.

2. Four *Numbers* are said to be *Proportional*, when the first containeth or is contained by the second, as often as the third containeth, or is contained by the fourth. *Vide Wingate's Arith. Chap.* 8. *Sect.* 4.

So these *Numbers* are said to be *Proportionals*, *viz.* 3, 6, 9, 18, for as often as the first *Number* is contained in the second, so often is the third contained in the fourth, *viz.* twice. Also 9, 3, 15, 5, are said to be *Proportional*, for as often as the first *Number* containeth the second, so often the third *number* containeth the fourth, *viz.* 3 times.

3. The Rule of Three is either simple, or composed.

4. The simple (or single) Rule of *three*, consisteth of 4 *Numbers*, that is to say, it hath 3 *Numbers* given to find out a fourth; and this is either Direct, or Inverse. *Vide Alsted. Math. lib.* 2. *Cap.* 13.

5 The single Rule of *three direct*, is when the *Proportion* of the first *term* is to the second, as the third is to the fourth; or when it is required that the *Number* sought (*viz.*) the fourth *Number* must have the same *Pro-*

portion

portion to the ſecond, as the third hath to the firſt.

6. In the Rule of *three*, the greateſt difficulty is (after the Queſtion is propounded)to diſcover the *order* of the 3 *terms*, *viz.* which is the firſt, which is the ſecond, and which the third, which that you may underſtand, obſerve, That (of the three given *Numbers*) two are always of one kind, and the other is of the ſame kind with the *Proportional Number* that is ſought; as in this Queſtion, *viz.* If 4 yards of Cloth coſt 12 ſhillings, what will 6 Yards coſt at that Rate? here the two *Numbers* of one kind are 4 and 6, *viz.* they both ſignifie ſo many yards; and 12 ſhillings is the ſame kind with the *Number* ſought, for the price of 6 yards is ſought.

Again, obſerve, that of the 3 given *numbers*, thoſe two that are of the ſame kind, one of them muſt be the firſt, and the other the third, and that which is of the ſame kind with the *number* ſought, muſt be the ſecond *number* in the Rule of *three*; and that you may know which of the ſaid *numbers* to make your firſt, and which your third, know this, that to one of thoſe two *numbers* there is always affixed a demand, and that *number* upon which the demand lieth muſt always be reckoned the third *Number*. As in the forementioned

mentioned Queſtion, the demand is affixed to the *number* 6, for it is demanded what 6 yards will coſt? and therefore 6 muſt be the third *number*, and 4 (which is of the ſame denomination (or kind) with it) muſt be the firſt, and conſequently the *number* 12, muſt be the ſecond, and then the *numbers* being plac'd in the forementioned order will ſtand as followeth, *viz.*

yards	*s.*	*yards*
4	12	6

7. In the Rule of *Three Direct* (having placed the *numbers* as is before directed, the next thing to be done will be to find out the fourth *number* in proportion, which (that you may do) Multiply the ſecond *number* by the third, and divide the Product thereof by the firſt, or (which is all one) multiply the third *term* (or *number*) by the ſecond, and divide the Product thereof by the firſt, and the Quotient thence ariſing is the fourth *number* in a direct proportion, and is the *Number* ſought, or Anſwer to the Queſtion, and is of the ſame denomination that the ſecond *number* is of. As thus, let the ſame Queſtion be again repeated, *viz.* If 4 yards of Cloth coſt 12 ſhillings, what will 6 yards coſt? Having placed my *numbers* according to the

the *6th.* Rule (of this Chapter) foregoing, I multiply (the second *number*) 12, by (the third *number*) 6, and the Product is 72, which Product I divide by (the first *number*) 4, and the Quotient thence arising is 18, which is the fourth *Proportional* or *number* sought, *viz.* 18 shillings, (because the second *number* is shillings) which is the Price of the 6 yards, as was required by the Question. See the Work following.

```
       yds.   s.   yds.   s.
  If   4----12----6----18
            6
           ---
       4)  72 (18 shillings
           ..
            4
           ---
           32
           32
           ---
           (0)
```

Quest. 2. Another Question may be this, *viz.* If 7 *C.* of Pepper cost 21 *l.* how much will 16 *C.* cost at that Rate?

To resolve which Question, I consider that (according to the 6 Rule of this Chapter) the *terms* or *numbers* ought to be placed

thus,

thus, *viz.* the Demand lying upon 16 *C.* it must be the third *number*, and that of the same kind with it must be the first, *viz.* 7 *C.* and 21 *l.* (being of the same kind with the *number* sought) must be the second *number* in this Question; then I proceed according to this 7*th.* Rule, and multiply the second *number* by the third, *viz.* 21 by 16, and the Product is 336, which I divide by the first *number* 7, and the Quotient is 48 *l.* which is the value of 16 *C.* of Pepper at the Rate of 21 *l.* for 7 *C.* See the Work as followeth.

```
     C.     l.     C.
If   7 ——— 21 ——— 16
           16
        ————————
          126
          21
         ————   l.
     7)  336  (48
          ..
          28
        ————————
           56
           56   facit 48 l.
         ——————
          (0)
```

8. If

8. If when you have divided the Product of the second and third *numbers* by the first, any thing Remain after Division is ended, such Remainder may be multiplied by the parts of the next inferiour Denomination, that are equal to an unit (or Integer) of the second *number* in the Question, and the Product thereof divide by the first *number* in the Question, and the Quotient is of the same denomination with the Parts by which you multiplied the Remainder, and is part of the fourth *number* which is sought. And furthermore, if any thing remain, after this last Division is ended, multiply it by the Parts of the next inferiour denomination equal to an unit of the last Quotient, and divide the Product by the same Divisor (*viz.* the first *number* in the Question) and the quote is still of the same denomination with your Multiplier; follow this method until you have reduced your Remainder into the lowest Denomination, *&c.* An Example or two will make the Rule very plain, which may be this following.

Quest. 3. If 13 yards of Velvet (or any other thing) cost 21 *l.* what will 27 yards of the same cost at that Rate?

Having ordered and wrought my Numbers according to the 6 and 7 Rules of this

Chapter

Chapter, I find the Quotient to be 43 *l.* and there is a Remainder of 8, ſo that I conclude the price of 27 *yards* to be more than 43 *l.* and to the intent that I may know how much more, I work according to the foregoing Rule, *viz.* I multiply the ſaid remainder 8, by 20 *s.* (becauſe the ſecond *number* in the Queſtion was Pounds) and the Product is 160, which divided by the firſt *number, viz.* 13, it quotes 12, which are 12 ſhillings, and there is yet a Remainder of 4, which I multiply by 12 pence, (becauſe the laſt Quotient was ſhillings) and the Product is 48, which I divide by 13, (the firſt *number*) and the Quotient is 3 *d.* and yet there remaineth 9, which I multiply by 4 *farthings*, and the Product is 36, which divided by 13 again, it quotes 2 *farthings*, and there is yet a Remainder of 10, which (becauſe it cometh not to the value of a *farthing*) may be neglected, or rather ſet (after the 2 *farthings*) over the Diviſor, with a Line between them, and then (by the 21 and 22 Definitions of the firſt Chapter of this Book) it will be $\frac{10}{13}$ of a *farthing*; So that I conclude, that if 13 *yards* of Velvet coſt 21 *l.* 27 *yards* of the ſame will coſt 43 *l.* 12 *s.* 3 *d.* 2$\frac{10}{13}$ *qrs.* which Fraction is ten thirteenths of a *farthing*. See the Operation as followeth.

If

yds. *l.* *yds.*

If 13----21----27

27

149

42

13) 567 (43 *l.*

52

47

39

Remains (8)

Multiply 20

13) 160 (12 *s.*

13

30

26

Remains (4)

Multiply 12

13) 48 (3 *d.*

39

Remains (9)

Multiply 4

qrs.

13) 36 ($2\frac{10}{13}$

26

l. *s.* *d.* *qrs.*

Remains 10 *facit* 43--12--.3--$2\frac{10}{13}$

Quest.

Quest. 4. Another Example may be this following, *viz.* If 14 *l.* of Tabaco cost 27 *s.* what will 478 *l.* cost at that rate?

Work according to the last Rule, and you will find it to amount to 921 *s.* 10 *d.* 1$\frac{2}{14}$ *qrs.* and by the 5*th.* Rule of the 8*th.* Chapter 921 *s.* may be reduced to 46 *l.* 01 *s.* So that then the whole worth or value of the 478 *l.* will be 46 *l.* 01 *s.* 10 *d.* 1$\frac{2}{14}$ *qrs.* the whole Work followeth.

If

	l.	s.	d.	
If	14	27	478	
			27	
			3346	
			956	
		14)	12906	(921
			126	
			30	
			28	
			26	
			14	
		Remains	(12)	
		Multiply	12	
			24	
			12	
		14)	144	(10
			14	
		Remains	4	
		Multiply	4	
			qrs.	
		14)	16	(1 $\frac{2}{14}$
			14	
		Rem.	(2)	

2|0) 92|1 (46

8

12

12

01

	l.	s.	d.	qrs.
Facit	46	01	10	1 $\frac{2}{14}$

9. In

9. In the Rule of 3, it many times happeneth, that although the first and third *numbers* be Homogeneal (that is, of one kind) as both money, weight, measure, *&c.* yet they may not be of one denomination, or perhaps they may both consist of many denominations, in which case you are to reduce both *numbers* to one denomination; and likewise your second *number* (if it consisteth (at any time) of divers denominations) must be reduced to the least name mentioned, or lower if you please, which being done, multiply second and third together, and divide by the first, as is directed in the 7*th*. Rule of this Chapter.

And note that always the Answer to the Question is in the same denomination that your second *number* is of, or is reduced to, as was hinted before.

Quest. 5. If 15 *ounces* of Silver be worth 3 *l.* 15 *s.* what are 86 *ounces* worth at that Rate?

In this Question the *numbers* being ordered according to the 6*th*. Rule of this Chapter, the first and third *numbers* are *ounces*, and the second *number* is of divers denominations, *viz.* 3 *l.* 15 *s.* which must be reduced to Shillings, and the shill. multiplied by the third *number*, & the product divided by the first, gives you the Answer in shillings, *viz.* 430 *s.* which are reduced to 21 *l.* 10 *s.* See the work.

If

	oz.	l.	s.	oz.
If	15	3	15	86

```
          20
        ------
          75
          86
        -------
          458
         600
       --------  2|0)    l.  s.
15) 6450 (43|0   21--10
     . . .
      60            4
    ------        -----
      45            3
      45            2
    ------        ------
     (0)          (10) shillings
```

In Resolving the last Question, the work would have been the same, if you had reduced your second *number* into *pence*, for then the Answer would have been 5160 pence, equal to 21 *l.* 10 *s.* or if you had reduced the Second *number* into *farthings*, the Quotient or Answer, would have been 20640 *farthings* equal to the same as you may prove at your leisure.

Quest. 6. If 8 *l.* of Pepper cost 4 *s.* 8 *d.* what will 7 *C.* 3 *qrs.* 14 *l.* cost?

In this Question the first *number* is 8 *l.* and the third is 7 *C.* 3 *qrs.* 14 *l.* which must be reduced to the same denomination with the first, *viz.* into pounds, and the second *number* must be reduced into pence; then Multiply and

and divide according to the *7th.* Rule forego-ing, and you will find the Answer to be 6174 *pence*, which is reduced into 25 *l.* 14 *s.* 6 *d.*

```
   l.   s.  d.              C.  qrs.  l.
If 8 cost 4---8 what will 7---3---14 cost ?
     12                    4
     --                  ----
     56                   31
                          28
                         ----
                         252
                         63
                        -----
                         882
                          56 second number
                       ------
                        5292
                       4410
                       ------    12)      2|0)   l.
                  8)  49392    (6174    (51|4  (25
                       ....      ...
                       48        60        4
                      ----      ----      ---
                        13        17       11
                         8        12       10
                       ----      ----     ----
                        59        54       14 shillings
                        56        48
                       ----      ----
                        32       (6) pence
                        32
                       ----          l.    s.    d.
                       (0)   Facit 25---14---06
```

Quest. 7. If 3 *C.* 1 *qr.* 14 *l.* of Raisins cost 9 *l.* 9 *s.* what will 6 *C.* 3 *qrs.* 20 *l.* of the same cost?

Here the first and third *numbers* each con-sist

ſiſt of divers denominations, but muſt be brought both into one denomination, *&c.* as you ſee in the operation which followeth; the Anſwer is 388 *s.* which is reduced into 19 *l.* 8 *s*:

```
    C. qrs. l.      l.  s.              C. qrs. l.
If  3---1---14 coſt 9--9 what will      6---3---20 coſt?
    4               20                  4
   ----            ----                ----
    13              189                 27
    28                                  28
   ----                                ----
    108                                 216
    27                                  56
   ----                                ----
    378 pounds                          776 pounds
                                        189 ſecond number
     6984                              ------
    6208                                        2|0)    l.  s.
    776                        378) 146664 (38|8    19--8
   ----                             ....    2
                                    1134   ----
    6                              ------   18
                                    3326    18
                                    3024   ----
                                   ------  (08) ſhillings
                                    3024
                                    3024            l.  s.
                                   ------  facit    19--8
                                    (0)
```

Queſt. 8. If in 4 *weeks* I ſpend 13 *s.* 4 *d.* how long will 53 *l.* 06 *s.* laſt me at that rate?

Anſwer,

Answer, 2238 *days* equal to 6 *years*, 48 *days*. See the Work.

```
   s.  d.            w.                  l.   s.
If 13--4 Require 4      what will 53--06 cost?
   12             7                  20
  ----          ----               ------
   30            28 days            1066
  13                                  12
  ---                              ------
  160 pence                          2132
                                    1066
                                   -------
                                    12792 pence
                                       28 sec. num.
                                   --------
                                   102336
                                   25584
                                  --------  365)
                        16|0) 35817|6(2238(6y.
                              . . . .   2190
                              32        -----
                             ----  Rem.(48)days
                              38
                              32
                             ----
                              61       Y. days
                              48 fa.  6-48,96
                             -----
                             137
                             128
                             ----
                        Remains (96)
```

Quest. 9. Suppose the yearly Rent of a House, a yearly Pension, or Wages be 73 *l.* I desire to know how much it is *per* day?

Here you are to bring the year into days, and say, if 365 days require 73 *l.* what will 1 day require?

Now when you come to multiply 73 by 1, the Product is the same, for 1 neither multiplieth nor divideth, and 73 cannot be divided by 365, because the Divisor is bigger than the Dividend, wherefore bring the 73 *l.* into shillings, and they make 1460, which divide by the first *number* 365, and the quote is 4 shillings for the Answer, as you see in the Work.

days *l.* *day*
If 365—73—1
20

365) 1460 (4 *s.*
1460 *facit* 4 *s. per* day.
(0)

Quest. 10. A Merchant bought 14 pieces of broad-cloth, each piece containing 28 *yards*, for which he gave after the Rate of 13 *s.* 6½ *d. per yard*, now I desire to know how much he gave for the 14 pieces at that Rate?

First,

First, find out how many yards are in the 14 pieces, which you will do if you multiply the 14 Pieces by 28 (the *number* of yards in a piece) and it makes 392, then ſay, If 1 yard coſt 13 *s.* 6½ *d.* what will 392 yards coſt? Work as followeth, and the Anſwer you will find to be 127400 half-pence, which reduced make 265 *l.* 8 *s.* 4 *d.* For after you have multiplied your ſecond and third *Numbers* together, the Product is 127400, which (according to the ſeventh Rule) ſhould be divided by the firſt *number*, but the firſt *number* is 1, which neither multiplieth, nor divideth, and therefore the Quotient or fourth *number* is the ſame with the Product of the ſecond and third, which is in half-pence, becauſe the ſecond *number* was ſo reduced. See the Work, as followeth.

```
            28
            14
          ----
           112
           28
          ----
           392 yards in the 14 pieces

 yd.    s.  d.                yds.
If 1 cost 13-6½ what will 392 cost?
        12                325 the second number
       ----              ------
        32               1960
        13               784
       ----             1176
       162              ------       2|0)     l.
         2         24)  127400      (530|8  (265
       ----              ....         ...
       325 half-pence   120           4
                        ----         ----
                         74           13
                         72           12
                        ----         ----
                                      10
     l.   s.  d.        200           10
Facit 265--8--4         192          ----
                        ----         (08) shillings
           Rem. (8) ½ pence, or 4 d.
```

Quest. 11. A Draper bought 420 *yds.* of broad-cloth, and gave for it after the Rate 14 *s.* 10¾ *per* Ell *English*, now I demand how much he paid for the whole at that Rate?

Bring your Ell into quarters, and your given yards into quaters, the Ell is 5 quarters,

ters, and in 420 yards are 1680 quarters, then say, If 5 quarters cost 14 *s.* $10\frac{3}{4}$ *d.* (or 715 *farthings*) what will 1680 quarters cost? *facit* 250 *l.* 05 *s.* 00 *d.* See the Operation.

Ell	*Yards*
1	420
5	4
5 *qrs.*	1680 *qrs.*

qrs. *s.* *d.* *qrs.*
If 5 —— 14 —— $10\frac{3}{4}$ —— 1680

14	1680	
12	715	
28	8400	
15	1680	
178 *d.*	11760	
4	96|0)	*l.*
715 *qrs.*	5) 1201200 (24024|0	(250
	10	192
	20	482
	20	480
	12	*Rem.* (240) *qrs.* or 5 *s.*
	10	
	20	
	20	
	(0)	

l. *s.* *d.*
Facit 250--05--00

Quest. 12. A Draper bought of a Merchant 50 pieces of Kerseys, each piece con-

taining 34 Ells *Flemish*, (the Ell *Flemish* being 3 quarters of a yard) to pay after the Rate of 8 *s.* 4 *d. per* Ell *English*, I demand how much the 50 *pieces* cost him at that rate?

First, find how many Ells *Flemish* are in the 50 pieces, by multiplying 50 by 34, the Product is 1700, which bring into quarters by 3, it makes 5100 quarters, then proceed, as in the last Question, and the Answer you will find to be 102000 pence, or 425 *l.* Behold the Operation, as followeth.

```
   qrs. s. d.            qrs.
If  5--8--4 ----------5100                  50
        12             100                  34
       ---      ------------       d.    ------
   100 d.   5) 510000 (102000             200
                                           150
                 5                       ------
               -----                    1700 Ells Flem.
                10                          3
                10                     --------
              ------                    5100 quarters
                (0)             2|0)     l.
           12) 102000    (850|0 (425
                 96        8
               -----     ----
                 60        5
                 60        4
               -----     ----
                (0)       10
                          10
      l.                 ----
Facit 425                 (0)
```

Quest. 13. A Goldſmith bought a Wedge of Gold which weighed 14 *l.* 3 *oz.* 8 *p.w.* for the Sum of 514 *l.* 4 *s.* I demand what it ſtood him in *per* Ounce? Anſwer 60 ſhillings, or 3 *l.* See the work.

l. *oz.* *p w.* *l.* *s.* *oz.*
If 14------3------8------514------4------1
12 20 *ſhillings* 20
———
31 10284 *ſhillings* 20 *p.w.*
14 20 *p. w.*
——— 2|0)
171 *oz.* 3428) 205680 (6|0 (3 *l.*
20 .. 6
——— 20568 ——— *s.* *l.*
3428 *p.w.* ——— (0) *facit* 60 *or* 3
(0)

Quest. 14. A Grocer bought 4 *hhds.* of Sugar, each weighing near 6 *C.* 2 *qrs.* 14 *l.* which coſt him 2 *l.* 8 *s.* 6 *d. per C.* I demand the value of the 4 *hhds.* at that Rate?

Firſt, find the weight of the 4 *hhds.* which you may do by reducing the weight of one of them into pounds, and multiply them by 4 (the Number of *hhds.*) and they make 2968 *l.* then ſay, If 1 *C.* or 112 *l.* coſt 2 *l.* 8 *s.* 6 *d.* what will 2968 *l.* coſt? *Facit* 64 *l.* 5 *s.* 3 *d.* as by the operation.

C. *qrs.* *l.*
6------2------14
4
26
28
212
53
742 *l. in* 1 *hhd.*
4 *hogsheads*
2968 *l. in* 4 *hhds.*

l. *l.* *s.* *d.* *l.*
If 112---2---8---6----2968
20 582
48 5936
12 23744
102 14840
48 112) 1727376 (15423 12) (1285 2|0) (64 *l.*
582

112 12 12
607 34 8
560 24 8
473 102 (05) *shill.*
448 96
257 63
224 60
336 (3) *pence*
336
(0)

l. *s.* *d.*
Facit 64——5——3

Quest.

Quest. 15. A Draper bought of a Merchant 8 packs of Cloth, each Pack containing 4 parcels, and each parcel 10 pieces, and in each piece 26 yards, and gave after the Rate of 4 *l*. 16 *s*. for 6 yards, now I desire to know how much he gave for the whole? Answer, 6656 *l*.

First, Find out how many yards there were in the 8 packs, as by the following work you will find there are 8320 yards; then say if 6 yards cost 4 *l*. 16 *s*. what will 8320 yards cost, &c.

```
                                              8 packs
                                              4
                                            ----
                                             32 parcels
                                             10
                                            ----
                                            320 pieces
                                             26
  yds. l.   s.      yds.                   -----
If 6---4----16---8320                       1920
       20          96                       640
      ----    ---------                    -----
       96        49920                      8320 yards
                74880
               --------  2|0)  l.
         6)  798720 (1391 1|0 (6656
             ......   .....
             6         12
            ---       ---
             19        13
             18        12
            ----      ----
              18        11
              18        10
             ----      ----
              07         12
               6         12
             ----      ----
              12        (0)
              12
Facit 6656 l. ----
             (0)
```

By this time the Learner is (I suppose) well Exercised in the Practick and Theorick of the Rule of 3 Direct, but at his leisure he may look over the following Questions, whose Answers are given, but the operation purposely omitted as a Touchstone for the Learner, thereby to try his Ability in what hath been delivered in the former Rules.

Quest. 16. If 24 *l.* of Raisins cost 6 *s.* 6 *d.* what will 18 Frails cost, each weighing Near 3 *qrs.* 18 *l.*? *Answer* 24 *l.* 17 *s.* 03 *d.*

Quest. 17. If an ounce of Silver be worth 5 shillings, what is the price of 14 Ingots, each Ingot weighing 7 *l.* 5 *oz.* 10 *p.w.*? *Answer*, 313 *l.* 05 *s.*

Quest. 18. If a piece of Cloth cost 10 *l.* 16 *s.* 8 *d.* I demand how many Ells *English* there are in the same, when the Ell at that Rate is worth 8 *s.* 4 *d*? *Ans.* 26 Ells *English*.

Quest. 19. A Factor bought 84 pieces of Stuffs, which cost him in all 537 *l.* 12 *s.* at 5 *s.* 4 *d. per* yard, I demand how many yards there were in all, and how many Ells *English* were contained in a piece of the same? *Answer* 2016 yards in all, and $19\frac{1}{5}$ Ells *English per* piece.

Quest. 20. A Draper bought 242 yards of Broad-cloth, which cost him in all 254 *l.* 10 *s.* for 86 yards of which he gave after the Rate of 21 *s.* 4 *d. per* yard, I demand how

how many he gave *per* yard for the Remainder? *Answer*, 20 *s.* 10 *d.* $\frac{64}{156}$ *per* yards.

Quest. 21. A Factor bought a certain quantity of Serge and Shalloon, which together cost him 226 *l.* 14 *s.* 10 *d.* the Quantity of Serge he bought was 48 yards at 3 *s.* 4 *d. per* yard, and for every 2 yards of Serge he had 5 yards of Shalloon, I demand how many yards of Shalloon he had, and how much the Shalloon cost him *per* yard? *Answer*, 120 yards of Shalloon at 1 *l.* 16 *s.* 05 $\frac{58}{120}$ *d. per* yard.

Quest. 22. An Oyl-man bought 3 Tun of Oyl, which cost him 151 *l.* 34 *s.* and it so chanced that it leaked out 85 gallons, but he is minded to sell it again, so as that he may be no loser by it, I demand how he must sell it *per* gallon? *Answer*, at 4 *s.* 6 $\frac{174}{671}$ *d. per* gallon.

Quest. 23. Bought 6 packs of Cloth, each pack containing 12 Cloths, which at 8 *s.* 4 *d. per* Ell *Flemish* cost 1080 *l.* I demand how many yards there were in each Cloth? *Answer* 27 yards in each Cloth.

Quest. 24. A Gentleman hath 536 *l per annum*, and his Expences are one day with another 18 *s.* 10 *d* 3 *qrs.* I desire to know how much he layeth up at the years end? *Answer*, 191 *l.* 03 *s.* 00 *d.* 1 *qr.*

Quest.

Quest. 25. A Gentlemen expendeth daily one day with another 27 *s.* $10\frac{1}{2}$ *d.* and at the years end layeth up 340 *l.* I demand how much is his yearly Income? *Answer*, 848 *l.* 14 *s.* 4 *d.* $\frac{1}{2}$.

Quest. 26. If I sell 14 yards for 10 *l.* 10 *s.* 00 *d.* how many Ells *Flemish* shall I sell for 283 *l.* 17 *s.* 06 *d.* at that Rate? *Answer* $504\frac{2}{3}$ Ells *Flemish*.

Quest. 27. If 100 *l.* in 12 Months gain 6 *l.* Interest, how much will 75 *l* gain in the same time, and at the same Rate? *Answer* 4 *l.* 10 *s.*

Quest. 28. If 100 *l.* in 12 Months gain 6 *l.* Interest, how much will it gain in 7 Months at that Rate? *Answer*, 3 *l.* 10 *s.*

Quest. 29. A certain Usurer put out 75 *l.* for 12 Months, and received Principal and Interest 81 *l.* I demand what Rate *per Cent.* he received Interest? *Answer* 8 *l. per Cent.*

Quest. 30. A Grocer bought 2 Chests of Sugar, the one weighed neat 17 *C.* 3 *qrs.* 14 *l.* at 2 *l.* 6 *s.* 8 *d* *per C.* the other weighed neat 18 *C.* 1 *qr.* 21 *l.* at $4\frac{1}{2}$ *d. per l.* which he mingleth together, now I desire to know how much a *C. weight* of this mixture is worth? *Answer* 2 *l.* 4 *s.* 3 *d.* $2\frac{5569}{4067}$ *qrs.*

Quest 31. Two men, *viz.* *A* and *B* departed both from one place, the one goes East, and the other West, the one travelleth 4 miles

miles a day, the other 5 miles a day, how far are they distant the *9th.* day after their departure? *Answer* 91 miles.

Quest. 32. *A* flying every day 40 miles, is pursued the 4*th.* day after by *B*, posting 50 miles a day, now the Question is in how many days, and after how many miles Travel will *A* be overtaken? *Answer*, *B* overtakes him in 32 days, when they have Travelled 600 miles.

Moore's Arithm. Chap. 8. *Quest.* 7.

11. The General Effect of the Rule of three Direct, is contained in the definition of the same, that is, to find a fourth Number in proportion consisting of two equal Reasons, as hath been fully shewn in all the foregoing Examples.

The second Effect is, by the price or value of one thing, to find the price or value of many things of like kind.

The third Effect is, by the price or value of many things to find the price of 1, or by the price of many things (the said price being 1) to find the price of many things of like kind.

The fourth Effect is, by the price or value of many things, to find the Price or value of many things of like kind.

The

The fifth Effect is, thereby to reduce any Number of Moneys, Weight, or Measure, the one sort into the other, as in the Rules of Reduction contained in the eighth Chapter foregoing. Examples of its various effects have been already answered.

12. The Rule of 3 Direct is thus proved, *viz.* Multiply the first Number by the fourth, and note the Product, then multiply the second Number by the third, and if this Product is equal to the Product of the first and fourth, then the Work is rightly performed, otherwise it is Erroneous.

The Proof of the Rule of Three Direct.

So the first Question of this Chapter (whose Answer, or fourth number we found to be 18 *s.*) is thus proved, *viz.* the first Number is 4, which multiplied by 18 (the fourth) produceth 72. And the second and third Numbers are 12 and 6, which multiplied together produce 72, equal to the Product of the first and fourth, and therefore I conclude the Work to be rightly performed.

Always observing, that if any thing Remain after you have divided the Product of the second and third Numbers, by the first, such Remainder in proving the same, must be added to the Product of the first and fourth

fourth *Numbers*, whose Sum will be equal to the Product of the second and third, (the second *number* being of the same denomination with the fourth, and the first with the same denomination of the third.)

So the Fourth Question of this Chapter being again repeated, *viz.* If 14 *l.* of Tabaco cost 27 *s.* what will 478 *l.* cost at that Rate? The Answer (or fourth *number*) was 46 *l.* 01 *s.* 10 *d.* 1 *qr.* $\frac{2}{14}$, which is thus proved, *viz.* bring the fourth *number* into *farthings*, and it makes 44249 which multiplied by the first *Number* 14, produceth 619488 (the second which remaineth being added thereto) then (because I reduced my fourth *number* into *farthings*) I reduce my second (*viz.* 27 *s.*) into *farthings* and they are 1296, which multiplied by the third *number* 478, their Product is 6 9488 equal to the Product of the *first* and *fourth Numbers*. Wherefore I conclude the operation to be true. This is an infallible way to prove the Rule of 3 *Direct*, and it is deduced from the twelfth *Section* of the ninth *Chapter* of this Book.

Thus much concerning the single rule of 3 *direct*, and I question not but by this time the Learner is sufficiently qualified to resolve any question pertinent to this Rule, not relying upon *Fractions*, or *Geometrical Magni-*

tudes.

tudes. Those that are desirous to see the demonstration of this Rule, let them read the sixth *Chapter* of (the ingenious) Mr. *Kersie*'s Appendix to *Wingate*'s Arithmetick. Or the sixth Chapter of Mr. *Oughtred*'s (Incomparable) *Clavis Mathematica*: By both which Authors this Rule is largely demonstrated, being grounded upon the 19*th. Prop.* of the 7*th.* and the 19*th. Prop.* of the 9*th.* of *Euclid. Elem.*

CHAP.

CHAP. XI.

The ſingle Rule of Three Inverſe.

1. THE Golden Rule, or Rule of 3 Inverſe, is when there are 3 *Numbers* given to find a fourth, in ſuch proportion to the 3 given *Numbers*, ſo as the fourth proceeds from the ſecond, according to the ſame Rate, Reaſon, or Proportion that the firſt proceeds from the third, or the Proportion is,

Alſted.Math. lib.2.cap.14.

As the third *number* is in proportion to the ſecond, ſo is the firſt to the fourth.

So if the 3 *numbers* given were 8, 12, and 16, and it were required to find a fourth *number* in an inverted proportion to theſe, I ſay that as 16 (the third *Number*) is the double of the firſt *term* or *number* (8) ſo muſt 12 (the ſecond *number*) be the double of the fourth; ſo will you find the fourth *term* or *number* to be 6. And as in the Rule of 3 *Direct*, you multiply the ſecond and third together, and divide their Product for

for a fourth *Proportional number*: So,

2. In the Rule of 3 *Inverse*, you must Multiply the second *term* by the first (or first *term* by the second) and divide the Product thereof by the third *term*, so the quotient will give you the fourth *term* sought in an Inverted *Proportion*. The same order being observed in this Rule, as in the Rule of 3 *Direct*, for placing and disposing of the given *numbers*, and after your *numbers* are placed in order, that you may know whether your Question be to be Resolved by the Rule *Direct* or *Inverse*, observe the general Rule following.

3. When your Question is stated, and your *numbers* orderly disposed, Consider in the first place whether the fourth *term* or *number* sought, ought to be more, or less than the second *term*; which you may easily do; And if it is required to be more, or greater than the second *term*, then the lesser *Extream* must be your Divisor, but if it require less, then the biggest *Extream* must be your Divisor, (in this Case the first and third *numbers* are called *Extreams* in Respect of the second) and having found out your Divisor, you may know whether your Question belong to the Rule *Direct* or *Inverse*; for if the third *term* be your Divisor, then it is *Inverse*, but if the first *term* be your Divisor,

then

then it is a *Direct* Rule. As in the following Queſtions.

Queſt. 1. If 8 Labourers can do a certain piece of work in 12 days, in how many days will 16 Labourers do the ſame? *Anſwer* in 6 days.

Having placed the *numbers* according to the 6*th*. Rule of the 10*th*. Chapter. I conſider that if 8 men can finiſh the work in 12 days, 16 men will do it in leſſer (or fewer days, than 12;) therefore the biggeſt *Extream* muſt be the Diviſor, which is 16; and therefore it is the Rule of 3 *Inverſe*,

lab.	*days*	*lab.*
8 ——	12 ——	16
	8	
	——	
16)	96	(6 *days*
	96	
	——	
	(0)	

Facit 6 *days*.

wherefore I multiply the firſt and ſecond *numbers* together, *viz.* 8 by 12 and their *Product* is 96, which divided by 16, Quotes 6 days for the *Anſwer*, and in ſo many days will 16 Labourers perform a piece of work, when 8 can do it in 12 days.

Queſt. 2. If when the meaſure (*viz.* a peck) of Wheat coſt 2 ſhillings, the penny Loaf weighed (according to the Standard, Statute, or Law of *England*) 8 Ounces, I demand

mand how much it will weigh when the peck is worth 1 *s.* 6 *d.* according to the ſame Rate or Proportion? *Anſwer*, 10 *oz.* 13 *p.w.* 8 *gr.*

Having placed and reduced the given *numbers* according to the 6 and 9 rules of the 10*th.* Chapter, I conſider that at 1 *s.* 6 *d. per* peck, the peny Loaf will weigh more than at 2 *s. per* peck, for as the price decreaſeth, the weight increaſeth, and as the price increaſeth ſo the weight diminiſheth, wherefore, becauſe the *term* requireth more than the ſecond, the leſſer *Extream* muſt be the Diviſor, *viz.* 1 *s.* 6 *d.* or 18 *pence*, and having finiſhed the work, I find the *Anſwer* to be 10 *oz.* 13 *p.w.* 8 *gr.* and ſo much will the peny Loaf weigh, when the peck of Wheat is worth 1 *s.* 6 *d.* according to the given Rate of 8 ounces, when the peck is worth 2 ſhillings, the work is plain in the following Operation.

s.   *s.*   *d.*

2 ———— 8 ———— 1 ———— 6

12   24   12

24   32   18

16

oz.   *p.w.*   *gr.*

18) 192 (10----13----8

Rem. (12)

20

p.w.

18) 240 (13

18

60

54

(6)

24

gr.

18) 144 (8

144

(0)

Quest. 3. How many pieces of Money or Merchandise at 20 *s. per* piece, are to be given, or Received for 240 pieces, the value or price of every piece being 12 shillings? *Answer* 144. For if 12 *s.* Require 240 pieces, then 20 shillings will require less; therefore the biggest *Extream* must be

be the Divisor, which is the third *number*, *&c.* See the Work.

```
     s.  pieces   s.
 If 12——240——20
            12
          ————
           480
          240
       ——————
 2|0) 288|0 (144 pieces at 20 s. per piece
       2
      ———
       8
       8
      ———
        8
        8
      ———
       (0)
```

Quest. 4. How many yards of 3 quarters broad are required to double, or be equal in measure to 30 yards, that are 5 quarters broad? *Answer* 50 yards. For say, if 5 quarters wide Require 30 yards long, what length will three quarters broad Require? Here I consider that 3 quarters broad will Require more

```
 qrs.  long   qrs.
  5——30——3
       5
     ————
 3)  150 (50 yards
      15
     ———
     (0)
```

more yards than 30, for the narrower the Cloth is, the more in length will go to make equal measure with a broader piece.

Quest. 5. At the Request of a Friend I lent him 200 *l.* for 12 Months, promising to do me the like Courtesie at my Necessity, but when I came to request it of him, he could let me have but 150 *l.* now I desire to know how long I may keep this Money to make plenary satisfaction for my former kindness to my Friend? *Answer* 16 Months.

I say, if 200 *l.* require 12 Months, what will 150 *l.* require? 150 *l.* will require more time than 12 Months, therefore the lesser *Extream* (*viz.* 150) must be the Divisor, Multiply and Divide, and you will find the fourth inverted *Proportional* to be 16, and so many months I ought to keep the 150 *l.* for satisfaction.

Quest. 6. If for 24 *s.* I have 1200 *l.* weight carried 36 miles, how many miles shall 1800 *l.* be carried for the same Money? *Answer* 24 miles.

Quest. 7. If for 24 *s.* I have 1200 *l.* carried 36 miles, how many pound weight shall I have carried 24 miles for the same Money? *Answer* 1800 *l.* weight.

Quest. 8. If 100 Workmen in 12 days finish a Piece of work or service, how many workmen are sufficient to do the same in

in 3 Days? *Answer*, 400 Work-men.

Quest. 9. A Colonel is besieged in a Town in which are 1000 Soldiers, with provision of Victuals only for 3 Months, the Question is, how many of his Soldiers must he dismiss, that his Victuals may last the remaining Soldiers 6 months? *Answer*, 500 he must keep and dismiss as many.

Quest. 10. If Wine worth 20 *l.* is sufficient for the Ord'nary of 100 men, when the Tun is sold for 30 *l.* how many men will the same 20 pounds worth suffice, when the Tun is worth 24 *l.*? *Answer*, 125 men.

Quest. 11. How much Plush is sufficient to line a Cloak which hath in it 4 yards of 7 quarters wide, when the Plush is but 3 quarters wide? *Answer*, $9\frac{1}{3}$ yards of Plush.

Quest. 12. How many yards of Canvas that is Ell wide, will be sufficient to line 20 yards of Say, that is 3 quarters wide? *Answer*, 12 yards.

Quest. 13. How many yards of Matting that is 2 foot wide, will cover a Floor that is 24 Foot long, and 20 Foot broad? *Answer*, 240 Foot.

Quest. 14. A Regiment of Soldiers consisting of 1000, are to have new Coats, and each Coat to contain 2 yards, 2 quarters of Cloth, that is 5 quarters wide, and they are to be lined with Shalloon, that is 3 quar-

ters wide, I demand how many yards of Shalloon will line them? *Answer*, 16666 quarters of Yards, or 4166¼ Yards.

Quest. 15. A Messenger makes a Journey in 24 days, when the day is 12 hours long, I desire to know in how many days he will go the same, when the day is 16 hours long. *Answer*, in 18 days.

Quest. 16. Borrowed of my Friend 64 *l.* for 8 Months, and he hath occasion another time for to borrow of me for 12 Months, I desire to know how much I must lend to make good his former kindness to me? *Answer*, 42 *l.* 13 *s.* 4 *d.*

4. The General Effect of the Rule of *Inverse* is contained in the Definition of the same, that is, to find a fourth *term* in a Reciprocal *Proportion*, inverted to the *Proportion* given.

The second Effect, is by two prices, or values of two several pieces of Money or Merchandise known, to find how many pieces of the one price is to be given for so many of the other. And consequently to Reduce and Exchange one sort of Money, or Merchandise, into another. Or contrariwise to find the price unknown of any piece given to Exchange, in Reciprocal *Proportion*.

The third Effect, is, by two different prices of a measure of Wheat bought or

sold

fold, and the weight of the Loaf of Bread, made anſwerable to one of the prices of the meaſure given, to find out the weight of the ſame Loaf, anſwerable to the other price of the ſaid meaſure given. Or contrariwiſe by the two ſeveral Weights of the ſame prized Loaf, and the price of the meaſure of Wheat anſwerable to one of thoſe Weights given, to find out the other price of the meaſure anſwerable to the other weight of the ſame Loaf.

The fourth Effect, is, by two lengths, and one breadth of two Rectangular Planes know, to find out another breadth unknown. Or by two breadths and one length given, to find out another length unknown in an inverted *Proportion*.

The fifth Effect, is, by double time and a Capital Sum of Money borrowed or lent, to find out another Capital Sum anſwerable to one of the given Times; or otherwiſe, by two Capital Sums, and a time anſwerable to one of them given to find out a time anſwerable to the other Capital Sum in Reciprocal Reaſon.

The ſixth Effect, is, by two differing Weights of Carriage, and the diſtance of the places in Miles or in Leagues given, to find another diſtance in miles anſwerable to the ſame price of payment; Or otherwiſe

by two diſtances in miles, and the weight anſwerable to one of the Diſtances (being carried for a certain price) to find out the weight anſwerable to the other diſtance for the ſame price.

The ſeventh Effect is by double workmen, and the time anſwerable to one of the *numbers* of workmen given, to find out the time anſwerable to the other *number* of workmen, in the performance of any work or ſervice. Or contrariwiſe, by double time, and the workmen anſwerable to one of thoſe times given, to find out the *number* of workmen anſwerable to the other time, in the performance of any work or ſervice.

Alſo by a double price of Proviſion, and the number of *men*, or other Creatures nouriſhed for a certain time, anſwerable to one of the prices of Proviſion given, to find out another *number* of Men or other Creatures anſwerable to the other price of the Proviſion for the ſame time. Or contrariwiſe by two *numbers* of Men or other Creatures nouriſhed, and one price of Proviſion anſwerable to one of the *numbers* of Creatures given, to find out the other price of the ſame Proviſion anſwerable to the other *number* of Creatures, both being ſuppoſed to be nouriſhed for the ſame, &c. As in the foregoing Examples is fully declared.

To

To prove the Operation of the Rule of 3 *Inverse*, multiply the third and fourth *terms* together, and note their Product; and multiply the first and second together, and if their Product is equal to the Product of third and fourth, then is the Work truly wrought, but if it falleth out otherwise then it is erroneous.

As in the first Question of this Chapter 16 (the third *number*) being multiplied by 6 (the fourth *number*) the Product is 96, and the Product of 8 (the first *number*) multiplied by 12 (the second *number*) is 96, equal to the first Product, which proves the work to be Right.

And Note, that if in Division any thing remain, such Remainder must be added to the Product of the third and fourth *terms*, and if the Sum be equal to the Product of the first and second (the homogeneal terms being of one denomination) the Work is right.

CHAP. XII.

The double Rule of Three Direct.

WE have already delivered the Rules of *Single Proportion*, and we come now to lay down the Rules of *Plural Proportion*.

1. *Plural Proportion*, is when more Operations in the Rule of Three than one, are required before a Solution can be given to the Question propounded. Therefore in Questions that require Plurality in *Proportion*, there are always given more than three *numbers*.

2. When there are given 5 *numbers*, and a sixth is required in *Proportion* thereunto, then this sixth *Proportion* is said to be found out by the double Rule of 3, as in the Question following, *viz.*

If 100 *l.* in 12 months gain 6 *l.* Interest, how much will 75 *l.* gain in 9 months?

3. Questions in the double Rule of 3 may be resolved either by two single Rules of three, or by one single Rule of 3 compounded of the 5 given *Numbers*.

4. The

4. The double Rule of three is either *Direct* or else *Inverse*.

5. The double Rule of 3 *Direct*, is when unto 5 given *numbers* a sixth *proportional* may be found out by two single Rules of Three *Direct*.

6. The five given *Numbers* in the double Rule of Three, consist of two Parts, *viz.* First, a Supposition, and Secondly, of a Demand; the Supposition is contained in the *three first* of the *five* given *Numbers*, and the Demand lies in the two last; as in the Example of the second Rule of this Chapter, *viz.* If 100 *l.* in 12 months gain 6 *l.* Interest, what will 75 *l.* gain in 9 months? here the Supposition is expressed in 100, 12, and 6, for it is said if (or suppose) 100 *l.* in 12 months gain 6 *l.* Interest; and the Demand lieth in 75 and 9; for it is demanded how much 75 *l.* will gain in 9 months?

7. When your Question is stated, the next thing will be to dispose of the given *Numbers* in due order and place, as a preparative for Resolution; which that you may do, First, observe which of the given *Numbers* in the Supposition is of the same Denomination with the *Number* required; for that must be the second *Number* (in the first *operation*) of the single Rule of 3, and one of the other *Numbers* in the Supposition

(it matters not which) must be the first *Number*, and that *Number* in the Demand which is of the same Denomination with the first, must be the third *Number*, which three *Numbers* being thus placed, will make one perfect Question in the single Rule of three, as in the forementioned Example; First, I consider, that the *Number* Required in the Question is the Interest or Gain of 75 *l.* therefore that *Number* in the Supposition which hath the same name (*viz.* 6 *l.* which is the Interest or Gain of 100 *l.*) must be the second *Number* in the first Operation, and either 100 or 12 (it matters not which) must be the first *Number*; but I will take 100, and then for the third *Number*, I put that *Number* in the Demand which hath the same Denomination with 100, which is 75, (for they both signify pounds principal) and then the *Numbers* will stand as you see in the Margent.

100—6—75

But if I had for the first *Number* put the other *Number* in the Supposition, *viz.* 12, which signifieth 12 Months, then the third *Number* must have been 9, which is that *Number*, in the Demand which hath the same Denomination with the first, *viz.* 9 months, and then they will stand as you see in the Margent.

10—6—9

There

There yet remain two *numbers* to be disposed of, and those are, one in the Supposition, and another in the Demand; that which is of the Supposition, I place under the first of the three *Numbers*, and the other which is in the Demand I place under the third *number*, and then

100	6	75
12		9

or thus.

12	6	9
100		75

2 of the *terms* in the Supposition will stand (one over the other) in the first place, and the 2 *terms* in the Demand will stand (one over the other) in the third place, as in the Margent.

8. Having disposed, or ordered the *numbers* given according to the last Rule, we may proceed to a Resolution, and first, I work with the three uppermost *Numbers*, which according to the first disposition are 100, 6, and 75, which is as much as to say, If 100 *l.* require 6 *l.* (Interest) how much will 75 *l.* require? which by the third Rule of the eleventh Chapter I find to be *Direct*, and by the 7 and 8 Rules of the tenth Chap. I find the fourth *Proportional number*, to be 4 *l.* 10 *s.* so that by the foregoing *single* Question I have discovered how much Interest 75 *l.* will gain in 12 mon. the operation whereof followeth on the left hand under the Letter *A*; and

having discovered how much 75 *l.* will gain in 12 months, we may by another Question easily discover how much it will gain in 9 months, for this fourth *number* (thus found) I put in the middle between the two lowest *Numbers* of the five after they are placed according to the seventh Rule of this Chapter; and then it will be a second *Number*, in another Question in the Rule of 3, the *numbers* being

m.	l.	s.	m.
12 —	4 —	10 —	9

the first and third *numbers* being of one Denomination, *viz.* both Months, and may be thus expressed, if 12 months require 4 *l.* 10 *s.* Interest, what will 9 months require? and by the third Rule of the eleventh Chapter, I find it to be the *Direct* Rule, and by working according to the directions laid down in the 7, 8, and 9 Rules of the tenth Chapter, I find the fourth *Proportional number* to the last single Question to be 3 *l.* 07 *s.* 06 *d.* which is the sixth *Proportional number* to the 5 given *numbers*, and is the Answer to the general Question. The work of the last single Question is expressed on the Right side of the Page under the Letter *B*, as followeth.

100

100——6——75

A 12

l.	l.	l.
If 100	6	75

75

30
42

l. s.

1|00) 4|50 (4:10
4

Remains (50)
Multiply 20

1|00) 10|00 (10 *s.*

l. *s.*
Facit 4--10

B 12

then say

	m.	*l.*	*s.*	*m.*
If	12	4	10	9

20

90 *shillings*
12

180
90

1080 *pence*
9

12) 2|0) l. s. d.
12) 9720 (810 (6|7 (3--7--6

96 72

12 90
12 84

(0) (6) *pence*

l. s. d.
Facit 3--7--6

So that by the foregoing Operation I conclude that if 100 *l.* in 12 months gain 6 *l.* Interest, 75 *l.* will gain 3 *l.* 7 *s.* 6 *d.* in 9 months, after the same Rate.

The

The Answer would have been the same, if the 5 given *Numbers* had been ordered according to the second method, *viz.* as you see in the Margent.

12—6—9
100 | 75

For first, I say, if 12 months gain 6 *l.* what will 9 months gain? this Question I find to be *Direct* by the 3*d.* Rule of the 11*th.* Chapter, and by the 7 and 8 Rules of the 10*th.* Chapter, I find the fourth *Proportional Number* to these three to be 4 *l.* 10 *s.*

Thus have I found out what is the Interest of 100 *l.* for 9 months, and I am now to find the Interest of 75 *l.* for 9 months; to effect which, I make this 4*th. Number* (found as before) to be my second *Number* in the next Question, and say, If 100*l.* require 4 *l.* 10 *s.* what will 75 *l.* require? this Question I find (by the said third Rule of the eleventh Chapter) to be *Direct*, and by the said 7*th*, 8*th*, and 9*th*, Rules of the tenth Chapter, I find the Answer to be as before, *viz.* 3 *l.* 7 *s.* 6 *d.*

This Rule hath been sufficiently explained by the foregoing Example, so that the Learner may be able to resolve the following (or any other) Questions pertinent to the double Rule of 3 *Direct*, whose Answers are there given, but the Operation purposely omitted

omitted to try the Learner's Ability in the Knowledge of what hath been before delivered.

Quest. 2. A second Example in this Rule may be as followeth, *viz.* A Carrier receiveth 42 shillings for the Carriage of 3 *C.* weight 150 Miles, I demand how much he ought to receive for the Carriage of 7 *C.* 3 *qrs.* 14 *l.* 50 miles at that Rate? *Answer*, 36 *s.* 9 *d.*

Quest. 3. A Regiment of 936 Soldiers eat up 351 quarters of Wheat in 168 Days, I demand how many quarters of Wheat 11232 Soldiers will eat in 56 Days at that Rate? *Answer*, 1404 *qrs.*

Quest. 4. If 40 Acres of Grass be mowed by 8 men in 7 Days, how many Acres shall be mowed by 24 men in 28 Days? *Answer*, 480 Acres.

Quest. 5. If 48 Bushels of Corn (or other Seed) yield 576 Bushels in 1 Year, how much will 240 Bushels yield in 6 Years at that Rate? that is to say, if there were sowed 240 Bushels every one of the 6 years? *Answer*, 17280 Bushels.

Quest. 6 If 40 shillings is the Wages of 8 men for 5 Days, what shall be the Wages of 32 men for 24 Days? *Answer*, 768 shillings, or 38 *l.* 8 *s.*

Quest. 7. If 14 Horses eat 56 Bushels of Provender

Provender in 16 Days, how many Bushels will 20 Horses eat in 24 Days? *Answer*, 120 Bushels.

Quest. 8. If 8 Cannons in 1 Day spend 48 Barrels of Powder, I demand how many Barrels 24 Cannons will spend in 12 Days at that Rate? *Answer*, 1728 Barrels.

Quest. 9. If in a Family consisting of 7 Persons, there are drunk out 2 *Kilderkins* of *Beer* in 12 days, how many *Kilderkins* will there be drunk out in 8 days, by another Family consisting of 14 Persons? *Answer*, 48 Gallons, or 2 Kilderkins and 12 Gallons.

Quest. 10. An *Usurer* put 75 *l.* out to receive Interest for the same, and when it had continued 9 months, he received for Principal and Interest 78 *l.* 7 *s.* 6 *d.* I demand at what Rate *per Cent. per Annum*, he received Interest? *Answer*, at 6 *l. per Cent. per Annum.*

CHAP.

CHAP. XIII.

The Double Rule of Three Inverse.

1. THE Double Rule of 3 *Inverse*, is, when a Question in the Double Rule of 3 is resolved by 2 Single Rules of 3, and one of those Single Rules falls out to be *Inverse*, or requires a fourth *number* in *Proportion Reciprocal* (for both the Questions are never *Inverse*.)

2. In all Questions of the Double Rule of 3 (as well *Inverse* as *Direct*,) you are (in the disposing of the 5 given *numbers*) to observe the seventh Rule of the twelfth Chapter, and in resolving of it by two single Rules, observe to make choice of your *Numbers* for the first, and second, single Questions according to the directions given in the eighth Rule of the same Chapter, as in the Example following, *viz.*

Quest. 1. If 100 *l.* Principal in 12 months gain 6 *l.* Interest, what Principal will gain 3 *l.* 7 *s.* 6 *d.* in 9 months?

This Question is an Inversion of the first Question

Question of the twelfth Chapter, and may serve for a proof thereof.

In order to a Resolution, I dispose of the 5 given *Numbers* according to the seventh Rule of the last Chapter, and being so disposed, will stand as followeth,

12 ——— 100 ——— 9				
6	l.	s.	d.	
	3 —	7 —	6	

Or thus,

	l.	s.	d.
6 ——— 100 ———	3 —	7 —	6
12	9		

Here observe, that according to the eighth Rule of the twelfth Chapter, the first Question, if you take it from the 5 *Numbers*, (as they are ordered or placed first) will be, If 12 months require 100 *l.* Principal, what will 9 months require to make the same Interest? this (according to the 3 Rule of the 11 Chapter) is *Inverse*, and the Answer will be found (by the 2 Rule of the 11*th*. Chapter) to be 133 *l.* 6 *s.* 8 *d.* the second question then will be, If 6 *l.* Interest, require 133 *l.* 6 *s.* 8 *d* Principal, how much Principal will 3 *l.* 7 *s.* 6 *d.* require? this is a direct Rule, and the Answer

swer in a direct *Proportion* is 75 *l.* See the Work.

First I say

	m.	l.	m.			
If	12	100	9			

12

l. s. d.

9) 1200(133—6—8

9 — 30 27 — 30 27 — (3) 20

l. s. d.

facit 133—6—8

9) 60 (6 *s.*
54
—
(6)
12
—
9) 72 (8 *d.*
72
—
(0)

then

Then I say,

```
   l.           l.      s.     d.    l.    s.   d.
If 6 ———————— 133 ——— 6 ——— 8 ---- 3 ---- 7 -- 6
  240 ———————— --20                  20
  ———          ————                 ————
  1440 d.      2666                  67
                 12                  12
               ————                 ————
               5340                 140
               2666                  67
               ————                ——————
               32000               810 d.
                 810
               —————
               320000
               256
               ——————
144|0) 2592000|0 (18000 d. or 75 l.
       ..
       144
       ————
       1152
       1152
       ————
       (0)
```

So that by the foregoing Work I find that if 6 *l.* Intereſt be gained by 100 *l.* in 12 months, 3 *l.* 7 *s.* 6 *d.* will be gained by 75 *l.* in 9 months.

But if the Reſolution had been found out by the *Numbers* as they are ranked in the ſecond place, then the ſecond Queſtion in the ſingle Rule would have been *Inverſe*,

and

and the first Question *Direct*, and the conclusion the same with the first method, *viz.* 75 *l.*

Quest. 2. If a Regiment consisting of 936 Soldiers can eat up 351 quarters of Wheat in 168 days, how many Soldiers will eat up 1404 quarters in 56 days at that Rate? *Answer*, 11232 Soldiers.

Quest. 3. If 12 Students in 8 Weeks spend 48 *l.* I demand how many Students will spend 288 *l.* in 18 Weeks? *Answer*, 32 Students.

Quest. 4. If 48 *l.* serve 12 Students 8 weeks, how many weeks will 288 *l.* serve 4 Students? *Answer*, 144 Weeks.

Quest. 5. If when the Bushel of wheat cost 3 *s.* 4 *d.* the peny Loaf weigheth 12 ounces, I demand the weight of the Loaf worth 9 pence, when the Bushel cost 10 *s.*? *Answer*, 36 ounces.

Quest. 6. If 48 Pioneers in 12 days cast a Trench 24 *yards* long, how many Pioneers will cast a Trench 168 *yards* long in 16 days? *Answer*, 252 Pioneers.

Quest. 7. If 12 *C.* weight being carried 190 miles cost 5 *l.* 12 *s.* I desire to know how many *C.* weight may be carried 150 miles for 12 *l.* 12 *s.* at that Rate? *Answer*, 18 *C.*

Quest. 8. If when Wine is worth 30 *l. per Tun*,

Tun, 20 pounds worth is sufficient for the ord'nary of 100 men, how many men will 4 *l.* worth suffice when it is worth 24 *l. per Tun*? *Answer*, 25 men.

Quest. 9. If 6 men in 24 Days mow 72 Acres, in how many days will 8 men mow 24 Acres? *Answer*, in 6 days.

Quest. 10. If when the Tun of Wine is worth 30 *l.* 100 men will be satisfied with 20 *l.* worth, I desire to know ~~what the~~ Tun is worth, when 4 *l.* worth will satisfie 25 men at the same Rate? *Answer*, 24 *l. per Tun*.

CHAP. XIV.

The Rule of Three Composed of five Numbers.

1. THE Rule of three Composed, is, when Questions (wherein there are 5 *Numbers* given to find a 6 in Proportion

tion thereunto) are resolved by one *single* Rule of 3 composed of the 5 given *Numbers.*

2. When Questions may be performed by the double Rule of 3 *Direct*, and it is required to resolve them by the Rule of 3 *Composed*, (first *Order* or *Rank* your *Numbers* according to the 7*th*. Rule of the 12*th*. Chapter, then)

The Rule is,

Multiply the *terms* (or *numbers*) that stand one over the other, in the first place, the one by the other, and make their *Product* the first *term* in the Rule of 3 *Direct*, then Multiply the *terms* that stand one over the other in the third place, and place their product for the third *term* in the Rule of 3 *Direct*, and put the middle *term* of the 3 uppermost for a second *term*, then having found a fourth *Proportional*, direct to these 3, this 4 *Proportional* so found, shall be the Answer *Required*.

So the first question of the 12 Chap. being proposed, *viz.* If 100 *l.* in 12 months gain 6 *l.* Interest, what will 75 *l.* gain in 9 months? the *numbers* being *Ranked* (or placed) as is there *Directed* and done.

Then I multiply the 2 first *terms*, 100 and 12, the one by the other, and their *Product* is 1200 (for the first *term*) then I multiply the two last *terms* 75 and 9 together,

ther, and their *Product* is 675 for the third *term*. Then I say, as 1200 is to 6, so is 675 to the Answer, which by the Rule of 3 *Direct* will be found to be 3 *l.* 7 *s.* 6 *d.* as was before found.

3. But if the Question be to be answered by the double Rule of 3 *Inverse*, then (having placed the 5 given *terms* as before) multiply the lowermost *term* of the *first* place, by the uppermost *term* of the *third* place, and put the *Product* for the *first term*; then multiply the uppermost *term* of the *first* place, by the lowermost *term* of the *third* place, & put the *Product* for the *third term*, and put the *second term* of the 3 highest *numbers* for the middle *term* to those two, then if the Inverse *Proportion* is found in the uppermost 3 *numbers*, the 4*th*. *Proportional* direct to these 3 shall be the Answer; so the first question of the 13*th*. Chap. being stated, *viz*. If 100 *l.* Principal in 12 Months gain 6 *l.* Interest, what Principal will gain 3 *l.* 7 *s.* 6 *d.* in 9 Months? State the *number* as is there directed in the first order, *viz*.

M.	l.	M.		
12———	100———	—9		
l.		l.	s.	d.
6		3·—	7—	·6

then

then reduce the 6 *l.* and 3 *l.* 7 *s.* 6 *d.* into pence, the 6 *l.* is 1440 *d.* and 3 *l.* 7 *s.* 6 *d.* is 810 *d.* then multiply 1440 by 9, the product is 12960 for the first *term* in the Rule of 3 *Direct*, and multiply 810 by 12, the product is 9720 for the third *term*, then I say, As 12960 is to 130 *l.* so is 9720 to the Answer, *viz.* 75 *l.* as before. But if the *terms* had been placed after the second order, *viz.*

l.	l.	l.	s.	d.
6	100	3	7	6
M.		M.		
12		9		

then the *Inverse* Proportion is found in the lowest *numbers*, and having composed the *numbers* for a single Rule of 3 as in the second Rule foregoing, then the Answer must be found by a single Rule of 3 *Inverse*, for here it falls out to multiply 810 by 12 for the first *number*, and 1440 by 9 for the third *number*, and then you must say, as 9720 is to 100 *l.* so is 12960 to the Answer, which by *Inverse Proportion* will be found to be 75 *l.* as before.

The questions in the 12 and 13 Chapters may serve for thy further experience?

CHAP.

CHAP. XV.

Single Fellowſhip.

1. FELLOWSHIP is that Rule of Plural *Proportion*, whereby we balance Accompts depending between divers Perſons having put together a general Stock, ſo that they may every man have his *Proportional* part of gain, or ſuſtain his *Proportional* part of loſs.

2. The Rule of Fellowſhip is either ſingle, or it is double.

3. The ſingle Rule is when the Stocks propounded are ſingle *numbers*, without any Reſpect or Relation to time, each Partner continuing his Money in Stock for the ſame time.

4. In the ſingle Rule of Fellowſhip, the *Proportion* is, As the whole Stock of all the Partners, is in *Proportion* to the total Gain or Loſs, ſo is each mans particular Share in the Stock, to his particular Share in the Gain or Loſs. Therefore take the total of all the Stocks for the firſt *term* in the Rule of 3, and the whole Gain or Loſs for the ſecond *term*, and

and the particular Stock of any one of the partners for the third *term*, then multiply and divide according to the 7*th*. Rule of the 9*th*. Chapter, and the 4*th*. *Proportional number* is the particular loſs or gain of him whoſe Stock you made your ſecond *number*, wherefore repeat the Rule of 3 as often as there are particular ſtocks, or Partners in the queſtion, and the 4*th*. *terms* produced upon the ſeveral operations are the Reſpective Gain or Loſs of thoſe particular Stocks given, as in the Examples following.

Queſt. 1. Two Perſons, *viz*. A and B bought a Tun of Wine, for 20 *l*. of which A paid 12 *l*. and B paid 8 *l*. and they gained in the Sale thereof 5 *l*. now I demand each mans ſhare in the Gains according to his Stock?

First I find the Sum of their Stocks, by adding them together, *viz*.

12 *l*. and 8 *l*. which are 20 *l*.	12
then according to this Rule	8
I ſay firſt, If 20 *l*. (the Sum	
of their Stocks) Require	20 *l*.
5 *l*. the total Gain, how	

much will 12 *l*. (the Stock of A) Require? Multiply and Divide by the ſeventh Rule of the ninth Chapter, and

the Answer is 3 *l.* for the *share* of A in the *gains*; then again I say, if 20 *l.* require 5 *l* what will 8 *l.* require? the *Answer* is 2 *l.* which is the *gain* of B. so I conclude that the *share* of A in the gain is 3 *l.* and the *share* of B in the gain is 2 *l.* which in all is 5 *l.*

```
     l.    l.    l.
If  20----5-----12
          12
          --
    20)   60 (3 l.
          60
          --
          (0)

     l.    l.    l.
If  20----5-----8
          8
          --
    20)   40 (2 l.
```

Quest. 2. Three Merchants, *viz.* A, B, and C, enter upon a joint Adventure; A, put into the common stock 78 *l.* B put in 117 *l.* and C put in 234 *l.* and they find (when they make up their Accompts) that they have gained in all 264 *l.* now I desire to know each man's *particular share* in the gains?

First I add their *particular* stocks together, and their Sum is 429 *l.* then say, If 429 *l.* gain 264 *l.* what will 78 *l.* gain? and what 117 *l.* and what will 234 *l.* (the stocks of A, B and C,) gain? work by 3 several Rules of 3, and you will find that

```
     l.
     78
    117
    234
    ---
Sum 429
```

			l.
The Gain of	A	is	48
	B		72
	C		144
		Sum	264

Quest. 3. Four Partners, *viz.* A, B, C, and D, between them built a Ship, which cost 1730 *l.* of which A paid 346 *l.* B 519 *l.* C 692 *l.* and D 173 *l.* and her Freight for a certain Voyage is 370 *l.* which is due to the Owners, or Builders, I demand each mans share therein according to his charge in building her?

Answer,

	l.
A	74
B	111
C	148
D	37
Sum	370

Quest. 4. A, B, and C, enter *Partnership* for a certain time, A put into the common stock 364 *l.* B put in 482 *l.* C put in 500 *l.* and they gained 867 *l.* now I demand each mans

ſhare in the gain *Proportionable* to his Stock

Anſwer,

	l.	s.	d.
A	234	09	$3\frac{354}{1346}$
B	310	09	$5\frac{62}{1346}$
C	322	01	$3\frac{930}{1346}$
Sum	867	00	0

5. To prove the Rule of *Single Fellowſhip*, add each mans *Particular* gains or loſs toge-ther, and if the total Sum is equal to the general gain or loſs, then is the Work rightly perform-ed, but otherwiſe it is erroneous. Example, in the firſt queſtio of this Chapter, the *Anſwer* was that th gain of A was 3 *l.* and the gain of B 2 l. which added together makes 5 *l.* equal to th total gain given.

The proof of the Rule of Single Fellowſhip.

If in finding out the *Particular ſhares* of th ſeveral *Partners*, any thing remain after Di-viſion is ended, ſuch Remainders muſt b added together (they being all Fractions o the ſame denomination) and their ſum divided by the Common Diviſor in each Queſtio (*viz.* the total ſtock) and the Quotient ad-

to the *Particular gains*, and then if the Total Sum is equal to the total gain the work is right, otherwiſe not.

As in the fourth queſtion, the Remainders were 354, 62, and 930, which added together make 1346 which divided by 1346 (the ſum of their ſtocks) the quotient is 1 *d.* which I add to the pence, *&c.* and the ſum of their ſhares is 867 *l.* equal to the Total Gain; wherefore I conclude the work is right.

CHAP. XVI.

Double Fellowſhip.

1. DOUBLE Fellowſhip, is when ſeveral perſons enter into *Partnerſhip* for unequal time, that is when every mans *Particular* ſtock hath Relation to a *Particular* time.

2. In the Double Rule of Fellowſhip, multiply each *particular* ſtock by its reſpective time, and having added the ſeveral products

together make their Sum the first *number*(or *term*) in the Rule of 3, and the total Gain or loss the second number, and the Product of any ones particular stock by his time, the third *term*, and the 4*th. number* in *Proportion* thereunto is his *Particular* gain or loss, whose Product of stock and time is your third *number*.

Then Repeat (as in single Fellowship) the Rule of 3, as often as there are products (or Partners) and the 4 *terms* thereby Invented are the *numbers* Required. *Example.*

Quest. 1. A and B enter *Partnership*, A put in 40 *l.* for 3 months, B put in 75 *l.* for 4 months, and they gained 70 *l.* now I demand each mans *share* in the gains, proportionable to his stock and time? *Answer*, A 20 *l.* B 50 *l.*

To resolve this Question, I first multiply the stock of A, (*viz.* 40 *l.*) by its time (3 months) and the product is 120, then I multiply the stock of B by its time (*viz.* 75 by 4) and it produceth 300, which I add to the Product of A his stock and time, and the sum is 420. Then

	l.		*l.*
	40		75
	3		4
A	120	B	300
			120
		Sum	420

by the Rule of 3 Direct, I say; As 420 (the Sum

Sum of the products) is to 70 (the total gain) so is 120 (the Product of A his Stock and time) to 20 *l.* (the *share* of A in the gains.) Then I say again as 420 is to 70, so is 300 to 50 *l.* (the *share* of B in the gains.) And so much ought each to have for his share.

Quest. 2. A, B, and C, make a Stock for 12 Months, A put in at first 364 *l.* and 4 Months after that, he put in 40 *l.* B put in at first 408 *l.* and at the end of 7 Months he took out 86 *l.* C put in at first 148 *l.* and 3 Months after he put in 86 *l.* more, and 5 Months after that, he put in 100 *l.* more, and at the end of 12 months their gain is found to be 1436 *l.* I desire to know each mans *share* in the gains according to his stock and time?

First, I consider, that the whole time of their *Partnership* is 12 Months. Then I proceed to find out the several products or stock and time as followeth.

A had at firſt 364 *l.* for 4 Months, wherefore their product is	1456
Then he put in 40 *l.* which with the firſt Sum makes 404 *l.* which continued the remainder of the time, *viz.* 8 Months, and their product is.	3232
The ſum of the products of the ſtock and time of A is	4688
B had 408 *l.* in 7 Months, whoſe product is	2856
And then took out 86 *l.* therefore he left in ſtock 322 *l.* which continued the reſt of the time, *viz.* 5 Months, whoſe product is	16.0
The Sum of the Products of the ſtock and time of B is	4466
C put in 148 *l.* for 3 months, whoſe product being multiplyed is	444
Then he put in 86 *l.* which added to the firſt (*viz.* 148) makes 234 *l.* which lay in ſtock 5 Months, their product is	1170

Then

Then he put in 100 *l.* more so then he had in stock 334 *l.* which continued the Remainder of the time (*viz.* 4 months) which multiplied together produce.	1336
The sum of the product of the money and time of C is	2950
B	4466
A	4688
The total Sum of all the product is	12104

Then I say, as 12104 is to 1436 (the total gain) so is 2950, to the *share* of A in the gains, *&c.* go on as in the foregoing Examples, and you will find their shares in the gain to be as followeth, *viz.*

Answer,

The *share* of		l.	s.	d.
A	is	556	03	$6\frac{6192}{12104}$
B	is	529	16	$9\frac{5495}{12104}$
C	is	349	19	$8\frac{416}{12104}$
		1436	00	00

Quest. 3. Three Grasiers, *A*, *B*, and *C*, take a piece of Ground for 46 *l.* 10 *s.* in which *A* put 12 Oxen for 8 Months, *B* put in 16 Oxen for 5 Months, and *C* put

18 Oxen for 4 Months, now the queſtion is, what ſhall each man pay of the 46 *l.* 10 *s.* for his ſhare in that charge?

Anſwer,

		l.	*s.*
A	ſhall pay	18	00
B	ſhall pay	15	00
C	ſhall pay	13	10
		46	10

3. The proof of this Rule is the ſame with that of *Single Fellowſhip*, laid down in the 5*th*. Rule of the 15*th*. Chapter; and note that,

If a loſs be ſuſtained inſtead of gain amongſt *Partners* every mans ſhare to be born in the loſs, is to be found after the ſame method as their gain, whether their ſtocks be for equal or unequal time.

CHAP.

CHAP. XVII.

Alligation Medial.

1. THE Rule of Alligation is that Rule in plural proportion, by which we resolve queſtions, wherein is a compoſition or mixture of divers ſimples, as alſo it is uſeful in the Compoſition of medicines both for quantity, quality, and price. And its ſpecies are two, *viz.* Medial and Alternate.

2. Alligation Medial is when having the ſeveral quantities, and prices of ſeveral ſimples propounded we diſcover the mean price, or Rate of any quantity of the mixture compounded of thoſe ſimples, and the proportion is,

As the ſum of the ſimples to be mingled is to the total value of all the ſimples, ſo is any part, or quantity of the Compoſition or Mixture, to its mean Rate or Price.

Queſt. 1. A Farmer mingleth 20 buſhels of wheat at 5 *s. per* buſhel, and 36 buſhels of rye at 3 *s. per* buſhel, with 40 buſhels of barly at 2 *s. per* buſhel, now I deſire to know what one buſhel of that mixture is worth?

To

To resolve this Question add together the given quantities and also their values, which is 96 bushels, whose total value is 14 *l.* 8 *s.* as appeareth by the work following, for

bush.		*l.* *s.*
20 *of wheat at* 5 s. per *bushel,*	*is*	05-00
36 *of rye at* 3 s. per *bushel,*	*is*	05-08
40 *of barly at* 2 s. per *bushel,*	*is*	04-00
The Sum of the given quantities is 96	*and their value is*	14-08

Then say by the Rule of 3 *Direct.*

If 96 *Bushels* cost (or is worth) 14 *l.* 8 *s.* what is 1 *Bushel* worth?

b.	l.	s.	b.
96	14	8	1
	20		
96)	288 (3 s.		
	288		
	(0)		

facit 3 s. *per bushel.*

Quest. 2. A Vintner mingleth 15 gallons of Canary at 8 *s. per* gallon with 20 gallons of Malaga at 7 *s.* 4 *d. per* gallon, with 10 gallons of Sherry at 6 *s.* 8 *d. per* gallon, and 24 gallons of white-wine at 4 *s. per* gallon, now

now I demand what a gallon of that mixture is worth? work as in the laſt Queſt. and you will find the anſwer to be 6 *s.* 2 *d.* 2 *qrs.* $\frac{46}{69}$.

Queſt. 3. A Grocer hath mingled 3 C. of Sugar at 56 *s. per C.* with 3 *C.* of Sugar at 3 *l.* 14 *s.* 8 *d per C.* and with 6 *C.* at 1 *l.* 17 *s.* 4 *d: per C.* I deſire to know the price of a hundred weight of that mixture? *Anſwer* 2 *l.* 13 *s.* 1 *d.* $\frac{7}{13}$.

The proof of Allig. medial.

3. The proof of this operation is by the price of any quantity of the mixture to find out the total value of the whole compoſition, and if it is equal to the total value of the ſeveral ſimples, the work is right, otherwiſe not. As in the firſt example, the anſwer to the queſtion was that 3 *s.* is the price of one buſhel, wherefore I ſay by the rule of proportion, If 1 buſhel be 3 ſhillings, what is 96 buſhels? *Anſwer* 14 *l.* 8 *s.* which is the total value of the ſeveral ſimples, wherefore the work is right.

CHAP.

CHAP. XVIII.

Alligation Alternate.

1. ALligation Alternate is when there are given the particular prices of ſeveral ſimples, and thereby we diſcover ſuch quantities of thoſe ſimples, as being mingled together ſhall bear a certain rate propounded.

2. When ſuch a Queſtion is ſtated, place the given prices of the ſimples one over the other, and the propounded price of the compoſition againſt them in ſuch ſort that it may repreſent a root, and they ſo many branches ſpringing from it as in the following Example.

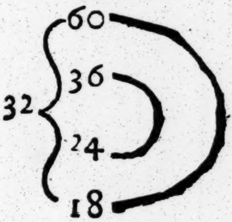
Queſt. 1. A certain Farmer is deſirous to mix 20 buſhels of wheat at 5 *s.* or 60 *d. per* buſhel with rye at 3 *s.* or 36 *d. per* buſhel, and with barly at 2 *s.* or 24 *d. per* buſhel, and Oats at 1 *s.* 6 *d. per* buſhel, and deſireth to mix ſuch a quantity of Rye, Barly and Oats with the 20 buſh. of wheat as that the whole compoſition may be worth 2 *s.* 8 *d.* or 32 *d. per* buſhel.

The prices of the ſimples being placed according to the laſt rule, with the price of the compoſition propounded as a root to them. will ſtand as followeth,

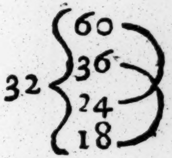
$$32 \left\{ \begin{array}{l} 60 \text{ \textit{pence}} \\ 36 \\ 24 \\ 18 \end{array} \right.$$

3. Having thus placed the given numbers you are to link or combine the ſeveral rates of the ſimples the one to the other, by certain arches, in ſuch ſort that one that is leſſer than the root (or mean rate) may be linked or coupled to another that is greater than the mean rate, ſo the queſtion laſt propounded will ſtand,

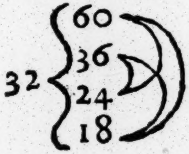
1 *thus,*



2 *or thus,*



3 *or thus,*



4. Then

4. Then take the difference between the root and the ſeveral branches, and place the difference of each againſt the Number or branch, with which it is coupled, or linked, and having taken all the Differences and placed them as aforeſaid, then thoſe differences ſo placed, will ſhew you the number of each ſimple to be taken to make a compoſition to bear the mean rate propounded.

So the branches of the laſt queſtion being linked together as in the firſt manner, I ſay the Difference between 32 and 60, is 28, which I put againſt 18, becauſe 60 is linked with 18, then the Difference between 32 and 36 is 4, which I put againſt 24, becauſe 36 is linked or coupled with 24, then I ſay the difference between 32 and 24 is 8, which I place againſt 36 (for the reaſon aforeſaid) then I ſay the Difference between 32 and 18 is 14, which I place againſt 60; and then the work will ſtand as you ſee in the margent.

32	60	14
	36	8
	24	4
	18	28

So I conclude that a compoſition made of 14 buſhels of wheat at 60 *d. per* buſhel, and

and 8 bushels of Rye at 36 *d. per* bushel, and 4 Bushels of Barly at 24 *d. per* bushel, and 28 bushels of Oats at 18 *d. per* bushel, will bear the mean price of 32 *d.* or 2 *s.* 8 *d. per* bushel. And here observe that in this composition there is but 14 Bushels of wheat; but I would mingle 20 bushels, and this kind (or rather case) of Alligation alternate (*viz.* when there is given a certain quantity of one of the simples, and the quantities of the rest sought to mingle with this given quantity, that the whole may bear a price propounded) is called Alternation partial.

And the proportion to find out the several quantities to be mingled with the given quantity is as followeth, *viz.*

As the difference annexed to the branch that is the value of an Integer of the given quantity, is to the other particular differences, so is the quantity given to the several quantities required.

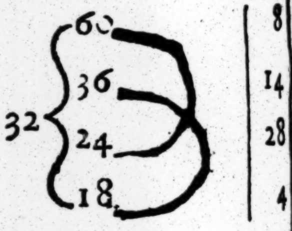
So here, to find out how much Rye, barly, and Oats must be mingled with the 20 bushels of wheat, I say by the single Rule of three direct, if 14 bushels of wheat require 8 bushels of Rye, what will 20 bushels of wheat require? answer $11\frac{6}{14}$ bushels of Rye.

Again if 14 bushels of wheat require 4 bushels of barly, what will 20 bushels of wheat

Wheat require? anſwer 5$\frac{10}{14}$ buſhels of Barly. Again, I ſay, if 14 buſhels of wheat require 28 buſhels of oats, what will 20 buſhels of wheat require? anſwer 40 buſhels of oats.

And now I ſay that 20 buſhels of wheat mingled with 11$\frac{6}{14}$ buſhels of Rye, and 5$\frac{10}{14}$ buſhels of barly, and 40 buſhels of oats, each bearing the rates as aforeſaid, will make a compoſition or heap of Corn that may yield 32 *d. per* buſhel.

But if the branches had been coupled according to the ſecond order, or manner, the differences would have been thus placed, *viz.* the differences between 32 and 60 is 28 which I ſet againſt 24, becauſe 60 is linked thereto; and the difference between 32 and 36 is 4, which I ſet againſt 18, and the difference between 32 and 24 is 8, which I ſet againſt 60; then the difference between 32 and 18 is 14, which I ſet againſt his yoke-fellow 36, and then I conclude that if you mix 8 buſhels of wheat with 14 buſhels of Rye, 28 buſhels of barly, and 4 buſhels of oats, each bearing the foreſaid prices, the whole mixture may be ſold for



for 32 *d. per* bushel, as by the work in the margent.

You see by this work we have found how many bushels of rye, barly, and oats, ought to be mixed with 8 bushels of wheat, and to find out how many of each ought to be mixt with 20 bushels of wheat, I say, As 8 is to 14, so is 20 to 35 bushels of rye. As 8 is to 28, so is 20 to 70 bushels of barly. As 8 is to 4, so is 20 to 10 bushels of oats; whereby I conclude, that if to 20 bushels of wheat, I put 35 bushels of rye, 70 bushels of barly, and 10 bushels of oats bearing each the foresaid prices *per* bush. that then a bushel of this mixture will be worth 32 *d.* or 2 *s.* 8 *d.*

And if the branches had been linked as you see in the third place, where each branch bigger than the root, is linked to two that are lesser than the root, then in this case you must have placed the several differences between the root and branches, against those two with which each is coupled, as first the difference between 32 and 60 is 28, which I put against 24 and 18 because it is coupled

32	60	8,14	22
	36	8,14	22
	24	28,4	32
	18	28,4	32

with

with them both, then the difference between 32 and 36 is 4, which I ſet likewiſe againſt 24 and 18, becauſe 36 is linked to them both, then the difference between 32 and 24 is 8, which I put againſt 60 and 36, becauſe 24 is linked to them both, then the difference between 32 and 18 is 14, which I put againſt 60 and 36, the yoke-fellows of 18.

Laſtly, I draw a line behind the differences, and add the differences which ſtand againſt each branch, and put the Sum behind the ſaid line againſt its proper branch, as you ſee in the margent.

And now by this work I find that 22 buſhels of wheat mingled with 22 buſhels of rye, and 32 buſhels of barly, and 32 buſhels of oats, each bearing the ſaid price will make a mixture, bearing the mean rate of 32 *d. per* buſhel.

And to find how much of each of the reſt muſt be mingled with 20 buſhels of wheat, I ſay,

As 22 is to 22, ſo is 20 to 20 buſhels of rye. As 22 is to 32, ſo is 20 to $29\frac{2}{22}$ buſhels of barly. As 22 is to 23, ſo is 20 to $29\frac{2}{32}$ buſhels of Oats.

Whereby you ſee the queſtions of Alligation alternate will admit of more true anſwers than one; for we have found three ſeveral anſwers

fwers to this first queſtion.

Queſtions of alternation partial are proved the ſame way with queſtions in Alligation medial, which you may ſee in the 3*d*. Rule of the 17*th*. Chapter.

The proof of alternation partial.

Queſt. 2. A Grocer hath 4 ſorts of Sugar, *viz*. of 12 *d. per l.* of 10 *d. per l.* of 6 *d. per l.* and of 4 *d. per l.* and he would have a compoſition worth 8 *d. per l.* the whole Quantity whereof ſhould contain 144 *l.* made of theſe 4 ſorts, I demand how much of each he muſt take?

Queſtions of this nature are reſolved by that part of Alligation alternate called by Arithmeticians alternation total, *viz.* where there is given the ſum, and prices of ſeveral ſimples to find out how much of each ſimple ought to be taken to make the ſaid Sum, or quantity, ſo that it may bear a certain rate propounded.

To reſolve this queſtion I place the ſeveral prices of the ſimples and mean rate propounded and link them together, as is directed in the 2 and 3 rules of this Chapter, and place the differences between the root and branches according to the 4*th*. Rule of this Chapter, which will then ſtand one of theſe three ways, *viz.*

First,

First.

$$8\left\{\begin{array}{l} 12 \\ 10 \\ 6 \\ 4 \end{array}\right.\quad \begin{array}{|c} 4 \\ 2 \\ 2 \\ 4 \\ \hline 12 \end{array}$$

Second.

$$8\left\{\begin{array}{l} 12 \\ 10 \\ 6 \\ 4 \end{array}\right.\quad \begin{array}{|c} 2 \\ 4 \\ 4 \\ 2 \\ \hline 12 \end{array}$$

Third.

$$8\left\{\begin{array}{l} 12 \\ 10 \\ 6 \\ 4 \end{array}\right.\quad \begin{array}{|c|c} 2,4 & 6 \\ 2,4 & 6 \\ 4,2 & 6 \\ 4,2 & 6 \\ \hline & 24 \end{array}$$

5. Then add the ſeveral differences together, which I have done, and the Sums of the 1*ſt*. and ſecond order are 12 *l* and of the third 24 *l*. as you may ſee above, but it is required that there ſhould be 144 *l*. of the compoſition, therefore to find the quantity of each ſimple, to make the whole compoſition 144 *l*. obſerve this general Rule, *viz*.

As the ſum of the differences is to the ſeveral differences, ſo is the total quantity of the compoſition to the quantity of each ſimple.

So to find how much of each ſort of Sugar

I

I ought to take to make 144 *l.* at 8 *d. per l.* I say,

1.

As 12 is to 4, so is 144 to 48 *l.* at 12 *d. per l.*
As 12 is to 2, so is 144 to 24 *l.* at 10 *d. per l.*
As 12 is to 2, so is 144 to 24 *l.* at 6 *d. per l.*
As 12 is to 4, so is 144 to 48 *l.* at 4 *d. per l.*

Whereby I find that 48 *l.* at 12 *d per l.* and 24 *l.* at 10 *d. per l.* and 24 *l.* at 6 *d. per l.* and 48 *l.* at 4 *d. per l.* will make a composition of Sugar containing 144 *l.* worth 8 *d. per l.*

But as the Branches are linked in the second order, the ans. will be 24 *l.* at 12 *d. per l.* and 48 *l.* at 10 *d. per l.* and 48 *l.* at 6 *d. per l.* and 24 *l.* at 4 *d. per l.* to make the said quantity, and to bear the said price.

And if you had worked as the Branches are linked after the third order, then you would have found the quantity of 36 *l.* of each.

Quest. 3. A Vinter hath 4 sorts of Wine, *viz.* Canary at 10 *s. per* gallon, Malaga at 8 *s. per* gallon; Rhenish wine at 6 *s. per* gallon; and white wine at 4 *s. per* gallon, and he is minded to make a Composition of them all of 60 gallons that may be worth 5 shillings per Gallon, I desire to know how much of each he must have?

The

The *numbers* or *terms* being ranked according to the ſecond Rule of this Chapter; the branches will be linked as followeth, and will admit of no other manner of coupling, becauſe there is but one branch that is leſſer than the Root, therefore all the reſt muſt be linked unto it; and the differences between the Root and the three firſt branches, *viz.* 10, 8, and 6, which are 5, 3, and 1, muſt be ſet againſt 4 becauſe they are all coupled with it, and the difference between the Root (*viz.* 5) and 4, which is 1, muſt be ſet againſt the 3 other, becauſe it is linked to them all; ſo I find 1 gall. of *Canary*, 1 gallon of *Malaga*, 1 gallon of Rheniſh wine, and 9 gallons of White wine, prized as above, being mingled together, will be worth 5 *s. per* gallon, the Sum being 12 gallons, but there muſt be 60 gallons, wherefore I ſay,

5	10	1	1
	8	1	1
	6	1	1
	4	5 3, 1.	9
			12

As 12 is to 1, ſo is 60 to 5 gallons of Can.
As 12 is to 1, ſo is 60 to 5 gallons of Mal.
As 12 is to 1, ſo is 60 to 5 gallons of Rhen.
As 12 is to 9, ſo is 60 to 45 gallons of White (wine

So that 5 gallons of Canary, 5 gallons of Malaga, 5 gallons of Rheniſh, and 45 gallons

lons of White-wine mingled together, will be in all 60 gallons, worth 5 *s. per* gallon, which was required.

Quest. 4. A Goldsmith hath Gold of 4 several sorts of fineness, *viz.* of 24 *Carects* fine, and of 22 *Carects* fine, of 20 *Carects* fine, and of 15 *Carects* fine. And he would mingle so much of each with alloy that the whole Mass of 28 ounces of gold so mingled may bear 17 *Carects* fine. I demand how much of each he must take, the second and third Rules of this Chapter being observed, (for instead of the alloy I put 0, because it bears no fineness, but it makes a branch in the Operation) the terms may be *alligated* and the differences added any of these 4 ways following, *viz.*

Read Chap. 2. *diff.* 2. *of this book.*

First thus.

	24	17	17
	22	2	2
17	20	1,17	19
	15	5,3	8
	0	7,3	10
		Sum	56

Secondly thus,

17	24	2	2
	22	17	17
	20	2, 17	19
	15	7, 3,	10
	0	5, 3,	8
		Sum	56

Thirdly thus,

17	24	2,	2
	22	2,	2
	20	2, 17	19
	15	7, 5, 3,	15
	0	3,	3
		Sum	41

Fourthly thus,

17	24	2, 17	19
	22	2, 17,	19
	20	2, 17,	19
	15	7, 5, 3	15
	0	7, 5, 3	15
		Sum	87

More ways may be given for the Alligating, or linking of the *terms* in this question

but

but these are sufficient for the industrious, and it shall also suffice to give an answer to the question as the terms are link'd the first way, not doubting but the ingenious practicioner will be able at his leisure, to find Answers to the other 3 ways, *viz.*

	oz.	*p.w*	*Car.*
As 56 is to 17, so is 28 to	8	10	of 24
As 56 is to 2, so is 28 to	10	00	of 22
As 56 is to 19, so is 28 to	9	10	of 20
As 56 is to 18, so is 28 to	4	00	of 15
As 56 is to 10, so is 28 to	5	00	of alloy

Thus much well practised and understood is sufficient for the understanding of Alligation.

The proof of Alternation Total.

In questions of Alternation Total, the Answer is given true, when the Sum of each of the quantity of simples found, agrees with the Sum or Quantity propounded; as in the last Question, the Answer was 8 *oz* 10 *p w.* of 24 Carects fine, 10 *oz.* of 22 Carects fine, 9 *oz.* 10 *p.w.* of 20 Carects fine, 4. *oz.* of 15 Carects fine, and 5 *oz.* of Alloy, which added together make 28 *oz.* the quantity propounded.

CHAP. XIX.

Reduction of Vulgar Fractions.

1. WHat a Vulgar Fraction is, and its parts and ſeveral kinds, hath been already ſhewed in the 19, 20, 21, 22, 23, 24, and 31 definitions of the firſt Chapter of this Book, which the Learner is deſired diligently to obſerve before he proceeds.

2. To reduce a Vulgar Fraction (which diſcovereth the Principal Knowledge of Fractions, and therefore ought greatly to be regarded) we ſhall diſcover plainly under theſe eight ſeveral heads (or Rules) following, *viz.*

1. To reduce a mixt number into an improper Fraction.

2. To reduce a whole number into an improper Fraction.

3 To reduce an improper Fraction into its equivalent whole (or mixt) number.

4. To

4. To Reduce a Fraction into its lowest *terms* equivalent to the Fraction given.

5. To find the value of a Fraction in the known parts of Coyn, Weight, Measure, *&c.*

6. To reduce a Compound Fraction to a simple one of the same value.

7. To Reduce divers Fractions having unequal denominators, to Fractions of the same value, having an equal denominator.

8. To Reduce a Fraction of one denomination to another of the same value.

I. *To Reduce a mixt Number to an improper Fraction.*

The Rule is, *Vide Chap.* 1. *defin.* 31.

Multiply the Integral part (or whole Number) by the denominator of the Fraction, and to the product add the Numerator, and that Sum place over the denominator for a new Numerator; so this new Fraction shall be equal to the mixt Number given. As for Example.

1. Reduce $18\frac{3}{7}$ into an improper *fraction*, multiply the whole number 18 by 7 the *denominator*, and to the product add the *numerator* 3, the Sum is 129 which put over the *denominator* 7, and it makes $\frac{129}{7}$ for the anſwer as *per margent.*

$$\begin{array}{c} 18\frac{3}{7} \\ 7 \\ \hline 129 \end{array}$$

facit $\frac{129}{7}$

2. Reduce $183\frac{5}{21}$ to an improper *fraction*, *facit* $\frac{2201}{12}$.

3. Reduce $56\frac{13}{22}$ to an improper *fraction*, *facit* $\frac{1189}{21}$.

II. *To reduce a Whole Number to an Improper Fraction.*

The Rule is,

Multiply the given *Number*, by the intended *denominator*, and place the product for a *numerator* over it. As *for example*;

Vide Ch. 1. *defin.* 23.

1. Let it be required to reduce 15 into a Fraction whoſe denominator ſhall be 12.

To

To effect which, I multiply 15 by the intended denominator (12) the product is 180, which I place over 12 as a *numerator* and it makes $\frac{180}{12}$ which is equal to 15, as was required; as *per* margent.

facit $\frac{180}{12}$

$$\begin{array}{r} 15 \\ 12 \\ \hline 30 \\ 15 \\ \hline 180 \end{array}$$

2. Reduce 36 into an improper Fraction whose denominator shall be 26, *facit* $\frac{936}{26}$.

3. Reduce 135 into an improper Fraction, whose denominator shall be 16, *facit* $\frac{2160}{16}$.

III. *To reduce an improper Fraction into its equivalent, whole or mixt number.*

The Rule is,

Divide the numerator by the denominator, and the quotient is the whole number equal to the Fraction, and if any thing remain put it for a numerator over the divisor. Example.

1. Reduce $\frac{436}{8}$ into its equivalent mixt number, divide the numerator 436 by the denominator 8 and the quotient is 54 and 4 remains, which put for a numerator over the divisor 8, the Answer is $54\frac{4}{8}$ as *per margent*.

facit $54\frac{4}{8}$

$$\begin{array}{r} 8)\,436\,(54 \\ \underline{40} \\ 36 \\ \underline{32} \\ 4 \end{array}$$

2. Reduce $\frac{3476}{15}$ to a mixt number, *facit* $231\frac{11}{15}$.

3. Reduce $\frac{15576}{136}$ to a mixt *number*, *facit* $114\frac{72}{135}$.

IV. *To Reduce a Fraction into its lowest terms equivalent to the Fraction given.*

The Rule is,

1. If the *numerator* and *denominator* are even numbers take $\frac{1}{2}$ of the one, and half of the other as often as may be, and when either of them falls out to be an odd number, then divide them by any number that you can discover will divide both *numerator* and *denominator* without any Remainder; and when you have thus proceeded as low as you can reduce them, then this new Fraction so found out shall be the *fraction* you desire, and will be in value equal

to

to the given *Fraction.* Example.

1. Let it be required to reduce $\frac{192}{336}$ into its lowest terms. First I take the half of the *Numerator* 192 and it is 96, then half of the *denominator* and it is 168, so that now it is brought to $\frac{96}{168}$, and next to $\frac{48}{84}$, and by halfing still to $\frac{24}{42}$ and their half is $\frac{12}{21}$ and now I can no longer half it, because 21 is an odd *number*, wherefore I try to divide them by 3, 4, 5, 6, *&c.* and I find 3 divides them both without any Remainder, and brings them to $\frac{4}{7}$ as *per margent.*

192	96	48	24	12	4
336	168	84	42	21	7

So I conclude $\frac{4}{7}$ thus found to be equal in value to the given *fractions* $\frac{192}{336}$.

2. What is $\frac{1036}{1184}$ in its lowest terms? *Answer* $\frac{7}{8}$.

3. What is $\frac{1342}{1586}$ in its lowest terms? *Answer* $\frac{11}{13}$.

There is yet another way more excellent than the former to reduce a *fraction* into its lowest terms, and that is by finding a common measurer, *viz.* the greatest *number* that will divide the *numerator* and *denominator* without any Remainder, and by that means reduce a *fraction* to its lowest terms at the first Work; and to find out this common measurer di-

Vide Ought. Cla. Math. Cap. 7.

vide the *denominator* by the *numerator*, and if any thing remains divide your Divisor thereby; and if any thing yet *remains*, then divide your last divisor by it; do so until you find nothing *remains*; then this last divisor shall be the greatest common measurer, which will divide both *numerator*, *denominator*, and reduce them into their lowest terms at one Work.

Example.

4. Reduce $\frac{228}{304}$ into its lowest terms by a common measurer. To effect which, I divide the *denominator*, 304 by the *numerator* 228 and there remains 76, then I divide 228, (the first Divisor) by 76 (the *Remainder*) and it quotes 3, and nothing *Remains*; wherefore the last Divisor 76 is the common measurer, by which I divide the *numerator* of the given *Fraction*, *viz.* 228, it quotes 3 for a new *numerator*, then I divide the *denominator* 304 by 76 and it quotes 4 for a new *denominator*, so that now I have found $\frac{3}{4}$ equal to $\frac{228}{304}$.

5. Reduce $\frac{6048}{7392}$ into its lowest terms by a common measurer, *facit* $\frac{9}{11}$.

6. Reduce $\frac{3081}{20382}$ into its lowest terms by a common measurer, *facit* $\frac{13}{83}$.

A Compendium.

Note that if the *Numerator* and *Denominator* of a *fraction*, and each with a Cypher

or Cyphers, then cut off as many Cyphers from the one as from the other, and the *remaining* figures will be a *fraction* of the ſame value, *viz.* $\frac{3400}{7100}$ will be found to be reduced to $\frac{34}{71}$ by cutting off the 2 Cyphers from the *numerator* and *denominator*, with a daſh of the Pen, thus, $\frac{34|00}{71|00}$, and $\frac{460}{700}$, will be $\frac{46}{70}$ thus $\frac{46|0}{70|0}$, &c.

V. *To find the Value of a Fraction in the known Parts of Coyn, Weight, &c.*

The Rule is,

Multiply the *numerator* by the parts of the next inferiour *denomination* that are equal to an Unit of the ſame *denomination* with the *Fraction*, then divide that Product by the *denominator*, and the quote gives you its value, in the ſame parts you multiplied by, and if any thing *remain* multiply it by the parts of the next inferiour *denomination*, and divide as before, do ſo till you can bring it no lower, and the ſeveral quotients will give you the value of the *fraction* as was required, and if any thing at laſt *remain* place it for a *numerator* over the former *denominator*, ſome few Examples will make the Rule plain.

1. What

1. What is the value of $\frac{27}{29}$ *l. Sterling*? To anſwer this queſtion I multiply the numerator 27 by 20 (the ſhillings in a pound) the product is 540, which I divide by 29 (the denominator) and the quotient is 18 *s.* and there remains 18 which I multiply by 12 pence and the product (216) I divide by the denominator 29, the quotient is 7 *d.* and 13 remains, which I multiply by 4 Farthings, the product is 52, which I ſtill divide by 29, the quotient is 1 farthing, and there remaineth 23, which I put for a Numerator over the denominator 29, ſo I find the value of $\frac{27}{29}$ *l.* to be 18 *s.* 7 *d.* 1 *qrs.* $\frac{23}{29}$. as by the following Operation, and after the ſame manner are the values of the fractions in the ſeveral examples following found out.

$\frac{27}{29}$ l.

27

Multiply 20

29) 540 (18 s.

29

250

232

Remains (18)

Multiply 12

36

18

29) 216 (7 d.

203

Remains (13)

Multiply 4

qrs.

29) 52 (1$\frac{23}{29}$

29

Remains (23)

s. d. qrs.

Facit 18—7—1$\frac{23}{29}$

2. What is the Value of $\frac{11}{15}$ *l. Sterling*? *facit* 14 *s.* 8.

3. What

3. What is the value of $\frac{28}{137}$ *l. Sterling?* *facit* 4 *s.* 1 *d.* $\frac{7}{137}$.

4. What is $\frac{16}{21}$ *C.* weight? *facit* 3 *qrs.* 1 *l.* 5 *oz.* $\frac{7}{21}$

5. What is $\frac{136}{371}$ *l. Troy* weight? *facit* 4 *oz.* 7 *p.w.* 23 *gr.* $\frac{179}{371}$

6. What is $\frac{41}{50}$ of a year? *Answer* 299 *da.* 7 *ho.* 12 *min.*

VI. *To Reduce a compound Fraction to a simple one of the same value.*

What a compound Fraction is, hath been shewed in Chap 1. Definition 24, and to Reduce it to a simple Fraction of the same Value.

The Rule is,

Multiply the Numerators continually and place the last product for a new Numerator, then multiply the denominators continually, and place the last product for a new denominator. So this single Fraction shall be equal to the compound fraction given. Example.

1. Reduce $\frac{2}{3}$ of $\frac{3}{5}$ of $\frac{5}{8}$ to a Simple Fraction.

Multiply the Numerators 2, 3, and 5, together,

ther, they make 30 for a new Numerator; then I multiply the denominators 3,5,and 8 together, and their product is 120 for a denominator, so the simple Fraction is $\frac{30}{120}$, and cutting off the Cyphers it is $\frac{3}{12}$ equal to $\frac{1}{4}$ by the fourth Rule foregoing.

$$\begin{array}{cc} 5 & 3 \\ 3 & 2 \\ \hline 15 & 6 \\ 8 & 5 \\ \hline 120 & 30 \end{array}$$

Facit $\frac{30}{120}$ or $\frac{3}{12}$ or $\frac{1}{8}$.

2. What is $\frac{7}{10}$ of $\frac{5}{9}$ of $\frac{4}{7}$ of $\frac{11}{12}$? *Answer* $\frac{1540}{7560}$ or $\frac{154}{756}$ or $\frac{77}{378}$ in its least terms.

3. What is $\frac{11}{12}$ of $\frac{13}{14}$ of $\frac{21}{29}$? *Answer* $\frac{3003}{4872}$.

By this you may know how to find the value of a Compound Fraction, *viz.* first reduce it to a simple one, and then find out his value by the 5*th.* Rule foregoing.

Example.

4. What is the value of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{9}{10}$ of a pound? *Answer* 11 *s.* 3 *d.*

VII *To*

VII. *To reduce Fractions of unequal Denominators to Fractions of the ſame Value, having equal Denominators.*

The Rule is,

Multiply all the Denominators together, and the Product ſhall be the Common Denominator. Then multiply each Numerator into all the denominators except its own, and the laſt Product put for a Numerator, over the Denominator found out as before: So this new Fraction is equal to that Fraction, whoſe Numerator you multiplied into the ſaid Denominators. Do ſo by all the Numerators given, and you have your Deſire.

Example.

1. Reduce $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$, and $\frac{7}{8}$ to a common Denominator.

Multiply the Denominators 4, 5, 6, and 8, together continually, and the product is 960 for the common Denominator; then multiply the Numerator 3 into the Denominators, 5, 6, and 8, and the product is 720, which is a Numerator to 960 (found as before) ſo $\frac{720}{960}$ is equal to the firſt Fraction $\frac{3}{4}$, then I proceed

ceed to find a new Numerator the second Fraction, *viz.* $\frac{4}{5}$, and I multiply 4 (into all the Denominators except its own; *viz.*) into 4, 6, and 8, which produceth $\frac{768}{960}$ equal to $\frac{4}{5}$, then multiply the Numerator 5, into the denominator 4, 5, and 8, the product is $\frac{800}{960}$ equal to $\frac{5}{6}$. Then multiply the Numerator 7 into the Denominators 4, 5, and 6, the product is $\frac{840}{960}$ equal to $\frac{7}{8}$ and the work is done; so that for $\frac{3\,4\,5}{4\,5\,6}$ and $\frac{7}{8}$ I have $\frac{720}{960}$, $\frac{768}{960}$, $\frac{800}{960}$, and $\frac{840}{960}$.

2. Reduce $\frac{11}{12}$, $\frac{14}{23}$, and $\frac{19}{21}$, into a common denominator, *faciunt* $\frac{5313}{5796}$, $\frac{3528}{5796}$, and $\frac{5244}{5796}$.

VIII. *To reduce a Fraction of one Denomination to another.*

1. This is either Ascending, or Desending. Ascending when a Fraction of a smaller is brought to a greater Denomination, and Descending when a Fraction of a greater Denomination is brought lower.

2. When a Fraction is to be brought from a lesser to a greater Denomination, then make of it a Compound Fraction by comparing it with the intermediate Denominations between it, and that you would have it reduced to, then (by the 6*th.* Rule foregoing) reduce your compound to a simple Fraction, and the work is done. Example.

Quest.

Quest. 1. It is required to know what part of a pound *sterling* $\frac{5}{7}$ of a peny is?

To resolve this, I consider that 1 *d.* is $\frac{1}{12}$ of a shilling, and a shilling is $\frac{1}{20}$ of a pound; wherefore $\frac{5}{7}$ *d.* is $\frac{5}{7}$ of $\frac{1}{12}$ of $\frac{1}{20}$ of a pound, which by the said *6th.* Rule I find to be $\frac{5}{1680}$ of a pound sterling of *English* Money.

Quest. 2. What part of a pound *Troy* weight is $\frac{4}{5}$ of a peny weight? *Answer* $\frac{4}{5}$ of $\frac{1}{20}$ of $\frac{1}{12}$ *l.* equal to $\frac{4}{1200}$ *l. Troy.*

3. When a Fraction is to be brought from a greater to a lesser denomination, then multiply the Numerator by the parts contained in the several denominations betwixt it, and that you would reduce it to; then place the last product over the denominator of the given Fraction. Example.

Quest. 3. I would reduce $\frac{3}{5}$ *l.* to the Fraction of a Peny? to do which I multiply the Numerator 3 by 20 and 12, the product is 720 which I put over the denominator 5, it makes $\frac{720}{5}$ of a peny, equal to $\frac{3}{5}$ *l.*

Quest. 4. What parts of an Ounce *Troy* is $\frac{5}{16}$ *l.*? Answer, $\frac{60}{16}$ *oz.*

CHAP.

CHAP. XX.

Addition of Vulgar Fractions.

1. IF your Fractions to be added have a common Denominator, then add all the Numerators together, and place their Sum for a Numerator to the common Denominator, which new Fraction is the sum of all the given Fractions; and if it be improper, reduce it to a whole, or mixt Number, by the 3d. Rule of the 19*th*. Chapter.

Quest. 1. What is the Sum of $\frac{7}{24}$, $\frac{9}{24}$, $\frac{16}{24}$, and $\frac{14}{24}$?

The Denominators are equal, *viz*. every one is 24, wherefore add the Numerators together, *viz*. 7, 9, 16, and 14, their Sum is 46, which put over the Denominator 24, it makes $\frac{46}{24}$ the Sum of the given Fractions, which will be reduced to the mixt Number $1\frac{22}{24}$ or $1\frac{11}{12}$.

2. But

2. But if the Fractions to be added have unequal Denominators, then Reduce them to a common Denominator, by the 7*th.* Rule of the 19*th.* Chap. and then add the Numerators together, and put the Sum over the common Denominator, &c. as before, in the last Example.

Quest. 2. What is the Sum of $\frac{3}{5}$, $\frac{7}{8}$, $\frac{9}{10}$, and $\frac{11}{12}$?

The Fractions reduced to a common Denominator are $\frac{2880}{4800}$, $\frac{4200}{4800}$, $\frac{4320}{4800}$, and $\frac{4400}{4800}$, the Sum of their Numerators is 15800, which put over the common Denominator, makes $\frac{15800}{4800}$ or $\frac{15}{48}$ equal to the mixt number $3\frac{14}{48}$ or $3\frac{7}{24}$ for the Sum Required.

Quest. 3. What is the Sum of $\frac{13}{17}$, $\frac{21}{49}$, and $\frac{36}{47}$? *Answer* $1\frac{37555}{39151}$.

3. If you are to add mixt numbers together, then add the fractional parts as before, and if their sum be an improper Fraction reduce it to a mixt number, and add its Integral part to the Integral parts of the given mixt Numbers, and the Work is done.

Quest. 4. What is the sum of $13\frac{3}{4}$ and $24\frac{5}{8}$?

First

First add the Fractions $\frac{3}{4}$ and $\frac{5}{8}$ the Sum is $1\frac{12}{32}$, then add this Integer 1, to 13 and 24, their sum is 38, and put after it the Fraction $\frac{12}{32}$ it is $38\frac{12}{32}$ for the *Answer*, or it is $38\frac{3}{8}$.

Quest. 5. What is the Sum of $48\frac{3}{7}$ $64\frac{5}{8}$ and $130\frac{3}{4}$? *Facit* $243\frac{180}{224}$, or $243\frac{45}{56}$.

4. If any of the Fractions to be added is a compound Fraction is must first be reduced to a simple Fraction by the *6th.* Rule of Chapter 19, and then add it to the rest according to the 2*d.* Rule of this Chapter. Example.

Quest. 6. What is the Sum of $\frac{3}{4}$, $\frac{5}{6}$, and $\frac{7}{8}$ of of $\frac{5}{6}$?

Reduce $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$ into a simple Fraction, and it is $\frac{105}{192}$ which reduced with the other two, and added are $1\frac{4686}{5760}$.

Quest. 7. What is the Sum of $\frac{11}{12}$ and $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{6}$? *Answer* $1\frac{5}{12}$.

5. If the Fractions to be added are not of one denomination, they must be so reduced, and then proceed as before.

Quest. 8. What is the Sum of $\frac{3}{4}$ *l.* and $\frac{5}{6}$ *s.*? Of the given Fractions here, one is of a pound, and the other the fraction of a shilling; and before you can add them together, you must reduce $\frac{5}{6}$ *s.* to the Fraction of a pound as the other is (by the 8*th.* Rule of Chapter 19) and it makes $\frac{5}{120}$ *l.* then $\frac{3}{4}$ *l.* and $\frac{5}{120}$ *l.* will be found to be $\frac{380}{480}$ *l.* or $\frac{38}{48}$ *l.* by the 7*th.* Rule of

Chapter

Chapter 19, and in its lowest terms $\frac{19}{24}$ *l.* by the 4*th* Rule of Chapter 19.

It would have been the same, if (by the latter part of the 8*th*. Rule of Chapter 19) you had reduced $\frac{3}{4}$ *l.* to the *fraction* of a shill. which you would have found to have been $\frac{60}{4}$ *s.* which added to $\frac{5}{6}$ *s.* by the said 17*th*. Rule of the last Chap. the Sum is 15 *s.* $\frac{20}{24}$, which is equal to the Sum found as before, *viz.* $\frac{19}{24}$ *l.* for (by the 5*th*. Rule of Chapter 19) the value of $\frac{19}{24}$ *l.* will be found to be 15 *s.* 10 *d.* and so will 15 *s.* $\frac{20}{24}$ be found to be just as much.

Quest. 9. What is the Sum of $\frac{2}{5}$ *l.* $\frac{3}{5}$ *s.* and $\frac{3}{5}$ *d.*? *Answer* $\frac{379500}{600000}$ or $\frac{3795}{6000}$ *l.* or in its lowest terms $\frac{253}{400}$.

CHAP.

CHAP. XXI.

Substraction of Vulgar Fractions.

1. THE Rules in Addition for reducing the given Fractions to one *denomination* are here to be observed; for before *Subtraction* can be made the *fractions* must be reduced to a common *denominator*, then *Subtract* one *numerator* from the other, and place the *remainder* over the common *denominator*, which *fraction* shall be the excess or difference between the given *fractions*. Example.

Quest. 1. What is the difference between $\frac{3}{4}$ and $\frac{5}{7}$? The given *fractions* are reduced to $\frac{21}{28}$ and $\frac{20}{28}$, then *Subtract* the *numerator* 20 from the *numerator* 21, and there remains 1, which being put over the *denominator* 28 makes $\frac{1}{28}$ for the answer or difference between $\frac{3}{4}$ and $\frac{5}{7}$.

Quest. 2. What is the difference between $\frac{5}{6}$ and $\frac{3}{5}$ of $\frac{5}{8}$?

Reduce the compound *fraction* $\frac{3}{5}$ of $\frac{5}{8}$ to a simple *fraction*, then proceed as before and the answer is $\frac{110}{240}$ equal to $\frac{11}{24}$.

2. When

2. When a *fraction* is given to be *Subtracted* from a whole *number*, *subtract* the *numerator* from the *denominator* and put the remainder for a numerator to the given *denominator*, and *subtract* an unit (for that you borrowed) from the whole number, and the remainder place before the *fraction* found as before, which mixt number is the remainder or difference sought. Example.

Quest. 3. *Subtract* $\frac{7}{10}$ from 48.

Answ. 47 $\frac{3}{10}$; for if you *Subtract* 7 (the *numerator*) from 10 (the *denominator*) there *remains* 3, which put over 10 is $\frac{3}{10}$ and 1 (I borrowed) from 48 rests 47, to which join $\frac{3}{10}$ and it makes 47 $\frac{3}{10}$ for the excess.

Quest. 4. *Subtract* $\frac{13}{21}$ from 57, *remains* 56 $\frac{8}{21}$.

3. If it is required to *Subtract* a *fraction* from a mixt number, or one mixt Number from another, reduce the *fractions* to a common *denominator*, and if the *fraction* to be *subtracted* be lesser than the other, then *subtract* the lesser numerator from the greater, and that is a numerator for the common denominator; then *subtract* the lesser integral part from the greater, and the *remainder* with the remaining *fraction* thereto annexed, is the

Difference

difference required between the two given mixt numbers. Example.

Quest. 5. Subtract $26\frac{3}{7}$ from $54\frac{5}{6}$.

First, Subtract $\frac{3}{7}$ *viz.* $\frac{18}{42}$ from $\frac{5}{6}$ *viz.* $\frac{35}{42}$, the remainder is $\frac{17}{42}$, then 26 from 54 remaineth 28, to which annex $\frac{17}{42}$ it makes $28\frac{17}{42}$ for the *Answer*.

4. But if the fraction to be substracted is greater than the Fraction from whence you subtract, then having first reduced the fractions to a common denominator, take the numerator of the greater fraction out of the denominator, and add the remainder to the numerator of the lesser fraction, and their Sum is a new numerator to the common denominator, which fraction note, then (for the unit you borrowed) add 1 to the integral part to be subtracted, and subtract it from the greater number, and to the remainder annex the fraction you noted before, so this new mixt number shall be the difference sought. *Example.*

Quest. 6. Subtract $14\frac{3}{4}$ from $29\frac{4}{7}$.

The fractions reduced are, *viz.* $\frac{3}{4}$ equal to $\frac{21}{28}$, and $\frac{4}{7}$ equal to $\frac{16}{28}$, now I should subtract $\frac{21}{28}$ from $\frac{16}{28}$, but I cannot, therefore I subtract 21 from 28, rests 7, which added to 16 (the lesser numerator) makes 23 for a numerator to 28, *viz.* $\frac{23}{28}$, then I come to the Integral parts 14 and 29, and say 1 that I borrowed and 14 is 15

which taken from 29 there rests 14, to which annexing $\frac{23}{28}$ it is 14 $\frac{23}{28}$ for the remainder or difference between $4\frac{3}{4}$ and $29\frac{4}{7}$.

Quest. 7. Subtract $36\frac{9}{10}$ from $74\frac{8}{9}$ *facit* $37\frac{49}{90}$.

CHAP. XXII.

Multiplication of Vulgar Fractions.

1. IF the Multiplicand and Multiplier are simple (or single) fractions, then multiply the numerators together for a new numerator, and the denominators for a new denominator, which new fraction is the product required.

Quest. 1. What is the product of $\frac{5}{7}$ by $\frac{9}{11}$ *facit* $\frac{45}{77}$.

For the numerators 5 and 9 being multiplied make 45, and the denominators 7 and 11 being multiplied make 77.

Quest. 2. What is the product of $\frac{18}{23}$ by $\frac{21}{37}$ *facit* $\frac{378}{851}$.

2. If the Fractions to be multiplied are mixt numbers reduce them to improper fractions by the 1*st*. Rule of the 19*th*. Chapter, then proceed as before.

Quest. 3. What is the product of $48\frac{3}{5}$ by $3\frac{5}{6}$?

The given mixt numbers being reduced to improper fractions are $48\frac{3}{5}$ equal to $\frac{243}{5}$, and $3\frac{5}{6}$ equal to $\frac{83}{6}$, now $\frac{243}{5}$ multiplied by $\frac{83}{6}$ according to the first Rule of this Chapter, produceeth $\frac{20169}{30}$ or $672\frac{9}{30}$.

Quest. 4. What is the product of $430\frac{6}{10}$ by $18\frac{3}{7}$? *facit* $\frac{555474}{70}$ or $7935\frac{24}{70}$.

3. If a compound fraction is to be multiplied by a simple Fraction, first Reduce the compound fraction into a simple fraction, then multiply the one by the other as is taught above.

Quest. 5. What is the Product of $\frac{16}{21}$ by $\frac{3}{4}$ of $\frac{5}{7}$ of $\frac{4}{5}$? the compound fraction $\frac{3}{4}$ of $\frac{5}{7}$ of $\frac{4}{5}$ reduced is $\frac{60}{140}$ or $\frac{6}{14}$ which multiplied by $\frac{16}{21}$ produceth $\frac{96}{294}$ which in its lowest term is $\frac{16}{49}$ for the Answer.

And if the multiplicand and multiplier are both compound fractions, reduce them both to simple ones, then multiply these new fractions as before, so have you the Product.

Quest. 6. What is the product of $\frac{3}{4}$ of $\frac{2}{3}$ by $\frac{1}{2}$ of $\frac{1}{2}$?

Answer, $\frac{18}{120}$ in its lowest terms $\frac{3}{20}$.

Quest. 7. what is the Product of $\frac{2}{3}$ of $\frac{3}{4}$ by $\frac{2}{5}$ of $\frac{5}{6}$?

Answ. $\frac{60}{360}$ or $\frac{6}{36}$, or in its least terms $\frac{1}{6}$.

4. If a fraction be to be multiplied by a whole number, put under the given whole number an unit for a denominator, whereby it will be an improper Fraction, then multiply these Fractions as before. Example.

Quest. 8. What is the Product of 24 by $\frac{2}{3}$?

Answ. $\frac{48}{3}$, for 24 by putting an unit under it will be $\frac{24}{1}$, and $\frac{24}{1}$ by $\frac{2}{3}$ produceth $\frac{48}{3}$ or 16.

Quest. 9. What is the Product of 36 by $\frac{9}{11}$? *Answer*, $\frac{324}{11}$ or $29\frac{5}{11}$.

CHAP. XXIII.

Division of Vulgar Fractions.

1. IF the dividend and the divisor are both simple Fractions, then multiply the numerator of the dividend into the denominator of the divisor, and the product is a new numerator, and multiply the denominator of the dividend into the numerator of the divisor and the product is a new denominator

minator, which new Fraction thus found, is the quotient you desire. Example.

*Q.*1. What is the quotient of $\frac{5}{8}$ divided by $\frac{3}{5}$? *A.* $\frac{25}{24}$ or $1\frac{1}{24}$, for 1*st*. I multiply (5) the numerator of the dividend into (5) the denominator of the divisor, and the product (25) is a numerator for the quotient, then I multiply (8) the denominator of the dividend into (3) the numerator of the divisor, and the product (24) I put in the quotient for a denominator, so I find $\frac{25}{24}$ is the quotient sought.

$$\frac{3}{5}\Big)\frac{5}{8}\Big(\frac{25}{24}$$

Qu. 2. What is the quotient of $\frac{10}{21}$ divided by $\frac{2}{3}$? *Answ.* $\frac{30}{42}$ equal to $\frac{5}{7}$ in its lowest terms.

2. But if you would divide a simple Fraction by a compound, or a compound by a simple, first reduce such compound to a simple Fraction, then go on as before.

Qu. 3. What is the quotient of $\frac{3}{10}$ divided by $\frac{3}{4}$ of $\frac{2}{3}$? *A* $\frac{36}{60}$ or $\frac{3}{6}$, first reduce $\frac{3}{4}$ of $\frac{2}{3}$ into a simple fraction and it is $\frac{6}{12}$, by which $\frac{3}{10}$ being divided, the quotient is $\frac{36}{60}$ equal in its least terms to $\frac{3}{6}$. And if the dividend, and divisor be both compound Fractions, reduce them both to simple Fractions, then divide the one by the other as in Rule 1 beforegoing.

Quest. 4. What is the quote of $\frac{2}{3}$ of $\frac{3}{4}$ divided by $\frac{1}{5}$ of $\frac{5}{6}$?

Answ. $\frac{180}{120}$ or $\frac{18}{12}$ or $1\frac{6}{12}$ or $1\frac{1}{2}$ in its lowest terms.

3. If the dividend, or divisor, or both are mixt numbers reduce them to improper fractions, and perform division as you were taught before. Example.

Quest. 5. What is the Quote of $12\frac{3}{4}$ divided by $21\frac{4}{5}$?

Answ. $\frac{255}{436}$, for $12\frac{3}{4}$ is equal to $\frac{51}{4}$ and $21\frac{4}{5}$ is equal to $\frac{109}{5}$, and the quote of $\frac{51}{4}$ divided by $\frac{109}{5}$ is as before, $\frac{255}{436}$.

4. If you divide a fraction by a whole number, or a whole number by a fraction, make the whole number an improper *Fraction* by putting an unit for a denominator to it as was taught in Rule 4 of Chap. 22. and then perform Division as before was taught. Example.

Quest. 6. What is the Quote of 8 divided by $\frac{3}{5}$?

Answ. $\frac{40}{3}$ which is equal to $13\frac{1}{3}$ being reduced as is before directed. See the work in the *margent.*

$$\frac{3}{5}\Big)\frac{8}{1}\Big(\frac{40}{3} \text{ or } 13\frac{1}{3}$$

Quest. 7. What is the Quotient of $\frac{3}{5}$ divided by 8? *Answ.* $\frac{3}{40}$, as *per margent.*

$$\frac{8}{1}\Big)\frac{3}{5}\Big(\frac{3}{40}$$

CHAP.

CHAP. XXIV.

The Rule of Three Direct in Vulgar Fractions.

1. AS in the *rule* of 3 in whole *numbers*, so likewise in *fractions*, you must see that the *fractions* of the first and third places be of the same denomination.

2. See that if any of the given *fractions* be compound, that they be reduced to simple of the same value.

3. If there are given mixt numbers, reduce them to improper *fractions* by the first Rule of Chap. 19.

4. If any of the 3 terms is a whole *number* make it an improper *fraction* by constituting unit for its *denominator*.

Having reduced your fraction as is directed in the 4 last *Rules*, then proceed to a resolution which is performed the same way as in whole *numbers*, respect being had to the *rules* delivered for the working of *Fractions*, *viz.* multiply the 2*d* and 3*d fraction* together

according to the 1 Rule of Chap. 22. and divide the product by the first *fraction*, according to the 1 Rule of Chap. 23. and the quotient is the Answer.

Or (which is better)

5. Multiply the numerator of the first *fraction* into the denominators of the second and third, and the product is a new *denominator*, then multiply the denominator of the first *fraction* into the *numerators* of the second and third, and the product is a new numerator; which new *fraction* is the *4th. Proportional*, or *answer*, which (if it is an improper *fraction*) must be reduced to a whole or mixt number by the 3 Rule of Chap. 19. Examples.

Quest. 1. If $\frac{3}{4}$ yards of Cloth cost $\frac{5}{8}$ *l.* what will $\frac{6}{10}$ *yds.* cost?

Having placed the given *fractions* according to the 6 Rule of Chap. 10. I proceed to the Resolution, and first I multiply the numerator of the first *fraction* (3) into 8 and 10, the *denominators* of the second and third *fractions*, and the product is 240 for a denominator, then I multiply 4 the denominator of the first *fraction* into 5 and 9 the Numerators of the second and third *fractions*,

yds.	*l.*	*yds.*	*l.*
$\frac{3}{4}$	$\frac{5}{8}$	$\frac{9}{10}$	$\frac{180}{240}$

facit $\frac{180}{240}$ *l.* equal to $\frac{3}{4}$ *l.*

fractions, the product is 180 for a numerator, which numerator 180 and denominator 240 make $\frac{180}{240}$ *l.* for the Answer, equal to $\frac{3}{4}$ *l.* or 15 *s.*

Quest. 2. If $\frac{2}{3}$ *l.* buy $\frac{5}{6}$ *yds* of Cloth, what will $\frac{11}{12}$ *yds* cost at that rate?

Answer, $\frac{132}{180}$ *l.* equal to $\frac{11}{15}$ *l.* or 14 *s.* 8 *d.*

Quest. 3. If $\frac{7}{8}$ *l.* cost $\frac{3}{4}$ *s.* what will $\frac{8}{9}$ *s.* buy?

Answer, $\frac{224}{216}$ *l.* equal to 1 $\frac{1}{27}$ *l.*

Quest. 4. If $\frac{3}{5}$ of an ell of *Holland* cost $\frac{1}{3}$ of a pound, how much will 12 $\frac{2}{5}$ ells cost at that rate?

Answer, $\frac{190}{27}$ equal to 7 $\frac{1}{27}$ *l.*

In resolving the last question and the two next, observe the 3*d.* Rule of this Chapter foregoing.

Quest. 5. If $\frac{9}{10}$ of a *C.* cost 284 *s.* what will 7 $\frac{1}{2}$ *C.* cost at that rate?

Answer 239 $\frac{7}{12}$ *s.* or 11 *l.* 19 *s.* 7 *d.*

Quest. 6. If 3 $\frac{1}{4}$ yards of Velvet cost 3 $\frac{5}{8}$ *l.* how much will 10 $\frac{1}{2}$ *yds* cost at that rate?

Answer, 11 $\frac{37}{52}$ *l.*

Quest. 7. If 3 *yds* of broad Cloth cost 2 $\frac{4}{5}$ *l.* what will 14 $\frac{3}{7}$ *yds.* cost.

Answ. 13 *l.* 9 *s.* 4 *d.*

In working the last question and the 4 next, observe the 4 Rule of this Chap. foregoing.

Quest. 8. If 14 *l.* of Pepper cost 14 *s.* 6 $\frac{3}{5}$ *d.* I demand the price of 73 $\frac{3}{4}$ *l.*

Answer 3 *l.* 16 *s.* 7 $\frac{43}{56}$ *d.*

Quest. 9. If 1 *l.* of Cochenele cost 1 *l.* 5 *s.* what will $36\frac{3}{13}$ *l.* cost?

Answer 45 *l.* 17 *s.* 6 *d.*

Quest. 10. If one *yd.* of broad-cloth cost $15\frac{5}{8}$ *s.* what will 4 pieces, each containing $27\frac{3}{7}$ *yds.* at that rate?

Answer, 85 *l.* 14 *s.* $3\frac{3}{7}$ *d.*

Quest. 11. A Mercer bought $3\frac{1}{2}$ *pcs.* of silk each piece qt. $24\frac{2}{3}$ ells at 6 *s.* $0\frac{3}{4}$*d.* *per* ell, I demand the value of $3\frac{1}{2}$ *pcs.* at that rate?

Answer, 26 *l.* 3 *s.* $4\frac{3}{4}$ *d.*

In solving the 4 next questions observe the 8 Rule of Chap. 19.

Quest. 12. If $\frac{2}{5}$ of an ounce of Silver cost 2 *s.* I demand the price of $11\frac{2}{3}$ *l.* at that rate? Answer, 35 *l.*

Quest. 13. If $1\frac{5}{7}$ *l.* of Gold is worth $61\frac{5}{7}$ *l.* *sterling*, what is 1 grain worth at that rate? Answer $1\frac{1}{2}$ *d.*

Quest. 14. If $\frac{3}{4}$ *yds.* of silk is worth $\frac{3}{4}$ of $\frac{5}{6}$ *l.* what is the price of $15\frac{2}{5}$ ells *Flemish*?

Answer, 9 *l.* 12 *s.* 6 *d.*

Quest. 15. If $\frac{2}{3}$ of $\frac{3}{4}$ of a pound of Cloves cost 6 *s.* $2\frac{2}{7}$ *d.* what cost the C: weight at that rate? Answer, 69 *l.* 6 *s.* 8 *d.*

Note that when the Answers to the questions in this and the next Chap. are given in *fractions*, they are given in their lowest Terms.

CHAP.

CHAP. XXV.

The Rule of Three Inverſe in Fractions.

1. IT hath been already taught (in the 3 rule of the 11 Chap.) how to diſcover when the 4th proportional number (to the 3 given numbers) is to be found out by a Rule of 3 direct, and when by a Rule of 3 inverſe, to which Rule the Learner is now referred.

2. When (in fractions) you find a queſtion to be ſolved by the Rule of 3 Inverſe, *viz* when the third term is the diviſor; then (having reduced the terms exactly according to the Rules in Chap. 24.) multiply the Numerator of the 3 fractions into the denominators of the ſecond and firſt fractions, and the Product is a new Denominator, then multiply the denominator of the third Fraction into the numerators of ſecond and firſt fractions and the product is a new numerator, which new fraction thus found is the anſwer to the queſtion.

Queſt.

Quest. 1. If $\frac{3}{4}$ of a yard of Cloth that is 2 *yds.* wide will make a Garment, how much of any other Drapery, that is $\frac{3}{5}$ of a yard wide will make the same garment?

Answ. $2\frac{1}{2}$ *yds.*

Quest. 2. Lent my Friend 46 *l.* for $\frac{4}{5}$ of a year, how much ought he to lend me for $\frac{7}{12}$ of a year.

Answer, $63\frac{3}{35}$ *l.*

Quest. 3. If $\frac{2}{3}$ of a yard of Cloth that is $2\frac{1}{3}$ yards wide will make any garment, what breadth is that Cloth, when $1\frac{3}{4}$ *yds* will make the same garment?

Answer, $\frac{56}{63}$ of a *yd.* wide.

Quest. 4. How many inches in length of a board that is 9 inches broad, will make a Foot square?

Answer 16 inches in length.

Quest. 5. If when the bushel of wheat cost $4\frac{3}{4}$ *s.* the peny Loaf weigheth $10\frac{2}{3}$ Ounces, what will it weigh when the bushel cost $8\frac{9}{10}$ *s.*?

Answer, $5\frac{185}{267}$ Ounces.

Quest. 6. If 12 men can mow $24\frac{1}{2}$ Acres in $10\frac{2}{3}$ days, in how many days will 6 men do the same?

Answer, in $21\frac{1}{3}$ days.

CHAP.

CHAP. XXVI.

Rules of Practice.

1. IN the single Rule of 3 when the first of the 3 Numbers in the Question (after they are disposed according to the *6th.* Rule of Ch. 10.) happeneth to be an unit (or 1) that question many times may be resolved far more speedily than by the Rule of 3, which kind of Operation is commonly called Practice, and indeed it is of excellent use amongst Merchants, Trades men and others, by reason of its speediness in finding a Resolution to such kind of Questions.

2. The chiefest question resolvable by these brief Rules may be comprehended under these seven general heads or cases following, *viz.*

When

When the given price of the integer consists

1. *Of farthings under 4*
2. *of pence under 12*
3. *of pence and farthings*
4. *Of shillings under 20*
5. *Of shill. pence and farthings*
6. *Of Pounds*
7. *Of pounds, shillings, pence, and farthings.*

It would be very convenient for the practical Arithmetician, to have by heart the several products of the nine digits multiplied by 12, for his speedy reducing pence into shillings, or shillings into pence, which he may gain by the following Table.

12 Times	1	is	12
	2		24
	3		36
	4		48
	5		60
	6		72
	7		84
	8		96
	9		108

3. Shillings are practically reduced into pounds thus, *viz.* cut off the figure standing in the place of units with a dash of the pen

pen and note it for ſhillings, then draw a line under the given number, and take half of the remaining figures (after the firſt is cut off) and ſet them under the line, and they are ſo many pounds, but if the laſt figure is odd then take the leſſer half and add 10 to the figure ſo cut off (as before) for ſhillings, as if I were to reduce 43658 Shillings into pounds, firſt I cut off the laſt figure (8) for ſhillings, then I take half of the remaining figures (4365) thus half of 4 is 2, which I put under the line, then ½ of 3 is 1, and becauſe 3 is an odd number, I make the next figure 6 to be 16, and I go on ſaying ½ of 16 is 8, and then ½ of 5 is 2 which is the laſt figure, wherefore becauſe 5 is an odd number, I add 10 to the 8 I cut off and it makes 18 *s.* ſo that I find it to be 2182 *l.* 18 *s.* as *per margent.*

4365	8
l.	s.
2182	18

4. It is likewiſe convenient that the Learner be acquainted with the practical Tables following, the firſt containing the Aliquot (or even) parts of a ſhilling, the ſecond containing the Aliquot parts of a pound.

The

The even parts of a shilling.

d.		s.
6	is	$\frac{1}{2}$
4		$\frac{1}{3}$
3		$\frac{1}{4}$
2		$\frac{1}{6}$
$1\frac{1}{2}$		$\frac{1}{8}$
1		$\frac{1}{12}$

The even parts of a pound.

s. — d.		l.
10—00	is	$\frac{1}{2}$
6—08		$\frac{1}{3}$
5—00		$\frac{1}{4}$
4—00		$\frac{1}{5}$
3—04		$\frac{1}{6}$
2—06		$\frac{1}{8}$
2—00		$\frac{1}{10}$
1—08		$\frac{1}{12}$
1—00		$\frac{1}{20}$

Case 1.

5. When the price of the Integer is a Farthing, then take the ſixth Part of the given Number, which will be ſo many three half-pences, and if any thing Remains it is Farthings, by the *7th.* Rule of Chapter 9, then conſider that three half-pence is $\frac{1}{8}$ of a ſhilling.

ſhilling, wherefore take the eighth part of them for ſhillings, and if any thing remain they are ſo many 3 half-pence, which Reduce into pounds by the 3*d.* Rule foregoing. Example. What comes 67486 *l.* to at a Farthing *per l.* Firſt, I take $\frac{1}{6}$ of 67486 and it is 11247 three half-pence and 4 Farthings or 1 peny; then $\frac{1}{8}$ of 11247 is 1405 *s.* and 7 remains, which is 7 three half pence or 10$\frac{1}{2}$ *d.* which with the 4 Farthings before make 11$\frac{1}{2}$ *d.* and 1405 ſhillings, which by the 3 Rule is 70 *l.* 5 *s.* In all 70 *l.* 5 *s.* 11$\frac{1}{2}$ *d.* for the *Anſwer.* See the Work following.

	d.
$\frac{1}{6}$	67486 *at* $\frac{1}{4}$ *per l.*
	d.
$\frac{1}{8}$	11247—1
$\frac{1}{20}$	140|5—10$\frac{1}{2}$
	l. *s.* *d.*
	70—5—11$\frac{1}{2}$ *facit.*

Other

Other Examples follow.

$\frac{1}{6}$	8576 *l.* at 1 *qrs.*
$\frac{1}{8}$	1429——2 *qrs.*
$\frac{1}{20}$	17|8—8 *d.*
	l. s. d.
	8---18---8 *facit*

$\frac{1}{6}$	6380 *l.* at 1 *qrs.*
$\frac{1}{8}$	1063——2 *qrs.*
$\frac{1}{20}$	13|2---11 *d.*
	l. s. d.
	6---12---11 *facit*

6. When the price of the Integer is 2 farthings, then take the third part of the given Number for so many three half pences, and the Remainder (if any) is half-pence, then take the eighth part of that for shillings as before, &c.

Examples.

$\frac{1}{3}$	7368 *l.* at 2 *qrs.*
$\frac{1}{8}$	2456
$\frac{1}{20}$	30|7
	l. s.
	15—7 *facit*

$\frac{1}{3}$	8347 *l.* at 2 *qrs.*
$\frac{1}{8}$	2782 2 *qrs.*
$\frac{1}{20}$	34|7——9 *d.* $\frac{1}{2}$
	l. s. d.
	17--7--9$\frac{1}{2}$ *facit*

7. When the price of the Integer is 3 farthings then take half the given Number for three half-pence, (and if any thing remain it is 3 farthings) then take the eighth of that for shillings as before, &c.

Examples

Examples.

$\frac{1}{2}$	4736 *l.* at 3 *qrs.*		$\frac{1}{2}$	5425 *l.* at 3 *qrs.*
$\frac{1}{8}$	2368		$\frac{1}{8}$	2712 3 *qrs.*
$\frac{1}{20}$	29|6		$\frac{1}{20}$	33|9
	l. s.			l. s. d. qrs.
	14----16 *facit*			16--19--0--3 *facit*

Case 2.

8. When the given price of the Integer, is a part, or parts of a shilling (*viz.* pence) divide the given Number of Integers (whose value is sought) by the Denominator, of the fraction Representing the even part, and the quote is shillings, (always minding the 7*th*. Rule of the 9*th*. Chap.) and those shillings may be reduced into *l.* by the 3*d*. Rule of this Chapter. Examp. Let it be required to find the value of 438 *l.* at 3 *d. per l.* I consider 3 *d.* is $\frac{1}{4}$ of a shilling, and 438 *l.* will cost so many 3 pences, wherefore I divide 438 by 4 the denominator of $\frac{1}{4}$, and the quote is 109 shillings, and 2 remains, which is 2 three pences or 6 *d.* the whole value is 5 *l.* 9 *s.* 6 *d.* as by the following work appeareth.

438 *l.*

$\frac{1}{4}$	438 *l.* *at* 3 *d.*
$\frac{1}{20}$	10|9 — 6

facit 5 *l.* 9 *s.* 6 *d.*

More Examples follow.

$\frac{1}{2}$	3574 *l.* *at* 6 *d.* *per l.*
$\frac{1}{20}$	178|7

facit 89 *l.* 7 *s.*

$\frac{1}{6}$	5316 *l.* *at* 2 *d.* *per l.*
$\frac{1}{20}$	88|6

facit 44 *l.* 6 *s.*

$\frac{1}{3}$	438 *l.* *at* 4 *d.* *per l.*
$\frac{1}{20}$	14|6

facit 7 *l.* 6 *s.*

$\frac{1}{8}$	6389 *l.* *at* 1 $\frac{1}{2}$ *d.* *per l.*
$\frac{1}{20}$	79|8 — 7 *d.* $\frac{1}{2}$

facit 39 *l.* 18 *s.* 7 *d.* $\frac{1}{2}$

$\frac{1}{4}$	879 *l.* *at* 3 *d.* *per l.*
$\frac{1}{20}$	21|9 — 9 *d.*

facit 10 *l.* 19 *s.* 9 *d.*

$\frac{1}{12}$	818 *l.* *at* 1 *d.* *per l.*
$\frac{1}{20}$	6|8 — 2 *d.*

3 *l.* 8 *s.* 2 *d.* *facit*

9. If

9. If the price of the Integer be pence under 12, and yet not an even part, then it may be divided into even parts, and so the parts of the given Number taken accordingly, and added together, as if it were 5 *d.* which is 3 *d.* and 2 *d.* *viz.* $\frac{1}{4}$ and $\frac{1}{6}$ of a shilling, first take $\frac{1}{4}$ of the given Number, and then $\frac{1}{6}$ thereof and add them together, and their Sum is the Answer in shillings, still observing Rule 7 of Chap. 9. for the Remainders, (if any be) then bring the shillings into pounds by the 3 Rule foregoing. Likewise 7 *d.* is $\frac{1}{3}$ and $\frac{1}{4}$, so 9 *d.* is $\frac{1}{2}$ and $\frac{1}{4}$, and 10 *d.* is $\frac{1}{4}$ and $\frac{1}{4}$, and 11 *d.* is $\frac{1}{3}$ and $\frac{1}{3}$ and $\frac{1}{4}$ of a shilling, or else many times your work may be shortned thus, *viz.* when the said given price is to be divided into even parts of a shilling or of a pound, after you have taken the first even part the other may be an even part of that part, as in the next example, where is given 439 *l.* at 5 *d.* *per l.* now I may divide it thus, *viz.* into 4 *d.* and 1 *d.* and 4 *d.* being $\frac{1}{3}$ of a shill., and 1 *d.* being $\frac{1}{4}$ of 4 *d.* I first take $\frac{1}{3}$ of 439 *l.* and it gives 146 *s.* 4 *d.* and for the 1 *d.* I take $\frac{1}{4}$ of 146 *s.* 4 *d.* which is 36 *s.* 7 *d.* which in all comes to 9 *l.* 2 *s.* 11 *d.* Examples follow.

l. d.
439 *at* 5 *per l.*

$\frac{1}{3}$ 146------4
$\frac{1}{4}$ 36------7

18|2---11

9 *l.* 2 *s.* 11 *d. facit*

ells d.
587 *at* 7 *per ell.*

$\frac{1}{3}$ 195----8
$\frac{1}{4}$ 146----9

34|2----5

17 *l.* 2 *s.* 5 *d. facit*

yds. d.
836 *at* 8 *per yd.*

$\frac{1}{3}$ 278------8
$\frac{1}{3}$ 278------8

55|7-----4

27 *l.* 17 *s.* 4 *d. facit*

yds. d.
417 *at* 9 *per yd.*

$\frac{1}{2}$ 208----6
$\frac{1}{2}$ 104-----3

31|2----9

15 *l.* 12 *s.* 9 *d. facit*

ells. d.
386 *at* 10

$\frac{1}{2}$ 193
$\frac{1}{3}$ 128-------8

32|1------8

16 *l.* 01 *s.* 8 *d. facit*

l. d.
534 *at* 11

$\frac{1}{3}$ 178
$\frac{1}{3}$ 178
$\frac{1}{4}$ 133-----6

48|9----6

24 *l.* 9 *s.* 6 *d. facit*

Case 3.

10. When the price of the Integer is pence and farthings, if it make an even part of a shilling, work as before, but if they are uneven, as peny farthing, peny three farthings, 2 *d.* 1 *qrs.* or 2 *d.* 3 *qrs.* 3 *d.* 3 *qrs.* or the like, then first work for some even part, and then consider what part the rest is of that even part, and divide that quotient thereby, then add them together and reduce them to pounds as before. Example. 3470 *l.* at 1 *d.* 1 *qrs. per l.* first I work for the peny by dividing 3470 by 12, for 1 *d.* is $\frac{1}{12}$ of a shilling, and the quote is 289 *s.* 2 *d.* then I conceive that 1 farthing is $\frac{1}{4}$ of a peny, and the Value at 1 farthing, will be $\frac{1}{4}$ of the value at 1 peny, and therefore I take $\frac{1}{4}$ of 289 *s.* 2 *d.* which is 72 *s.* 3 *d.* 2 *qrs.* and add them together and they are 18 *l.* 1 *s.* 5 *d.* 2 *qrs.* as by the margent. Other Examples of the same nature follow.

l.	*qrs.*
3470 *at* 5	
289—2	
72—3—2	
36|1—5—2	
l. s. d. qrs.	
18--1--5--2	

	l.	*d.*
$\frac{1}{12}$	4360 *at*	$1\frac{1}{4}$
$\frac{1}{4}$	363 —	4
	90 —	10
	45|4 --	2
	l. *s.* *d.*	
	22 14 2 *facit*	

	yds.	*d.*
$\frac{1}{8}$	573 *at*	$1\frac{3}{4}$
$\frac{1}{6}$	71 —	$7\frac{1}{2}$ *d.*
	11 --	$11\frac{1}{4}$
	8|3 —	$6\frac{3}{4}$
		l. *s.* *d.*
	facit	4 --- 3 --- $6\frac{3}{4}$

$\frac{1}{6}$	485 *l.* at	$2\frac{1}{4}$ *d.*
$\frac{1}{8}$	80 —	10 *d.*
	10 —	$1\frac{1}{4}$
	9|0 —	$11\frac{1}{4}$
	4 *l.* 10 *s.* $11\frac{1}{4}$ *d.*	

$\frac{1}{2}$	520 *yds.* at	$7\frac{1}{2}$
$\frac{1}{4}$	260	
	65	
	32|5	
	16 *l.* 5 *s.* *facit*	

$\frac{1}{6}$	654 *l.* at	$2\frac{1}{2}$ *d.*
$\frac{1}{4}$	109	
	27 —	3 *d.*
	13|6 —	3
	6 *l.* 16 *s.* 3 *d.*	

	137 *yds. at*	$10\frac{1}{2}$ *d.*
$\frac{1}{2}$	68 —	6 *d.*
$\frac{1}{2}$	34 —	3
$\frac{1}{8}$	17 —	$1\frac{1}{2}$
	11|9 —	$10\frac{1}{2}$ *d.*
	5 *l.* 19 *s.* $10\frac{1}{2}$ *d.* *facit*	

Case 4.

Case 4.

11. When the price of the Integer is 2 *s.* then cut off the figure in the place of Units of the given number and double it for shillings, and the figures on the other hand are pounds. Example, 436 *yds.* at 2 *s. per yd.* cut off the last figure 6 and double it, it makes 12 shill. and the other 2 figures, *viz.* 43 are so many pounds, so that their Value is 43 *l.* 12 *s.* as *per margent.*

43|6

43 *l.* 12 *s.*

12. Hence it is evident that (when the given price of an integer is an even Number of shillings, then if you take half of that (even) number of shillings, and multiply the given number of integers thereby, doubling the first figure of the product, and setting it apart for shill. the rest of the product will be pounds, which pounds and shill. is the value sought. Example. What cost 536 *yds.* at 8 *s. per yd.*? to resolve which I take ½ of 8 *s.* (the price of a *yd*) which is 4, and multiply 536 thereby, saying 4 times 6 is 24, then I double the first figure 4 makes 8 for shill. and carry 2 to the next product, &c. I find the rest of the product to be 214 which I note

536 *yds* at 8 *s.*

214 *l.* 8 *s.*

for pounds, ſo the value of 536 *yds.* at 8 *s. per yd.* is 214 *l.* 8 *s.* as *per* Margent. More examples follow.

56 *yds. at* 6 *s. per yd.*	420 *yds. at* 12 *s. per yd.*
16 *l.* 16 *s. facit.*	252 *l. facit.*
123 *yds. at* 4 *s. per yd.*	326 *yds. at* 14 *s. per yd.*
24 *l.* 12 *s. facit.*	228 *l.* 4 *s. facit.*
48 *ells at* 8 *s. per ell.*	48 *yds. at* 16 *s. per yd.*
19 *l.* 4 *s. facit.*	38 *l.* 8 *s. facit.*
84 *yds. at* 10 *s. per yd.*	52 *yds. at* 18 *s. per yd.*
42 *l. facit.*	46 *l.* 16 *s. facit.*

13. If the given price of the Integer is an odd number of ſhillings, then work firſt for the even number of ſhillings by the laſt Rule, and for the odd ſhilling take $\frac{1}{20}$ of the given number of Integers according to the 3 Rule of this Chap. and add them together, and you have your deſire. Examples follow.

yds. *s.*
422 *at* 3 *per yard*

l. *s.*
42---4
21---2
63---6 *facit*

ells *s.*
431 *at* 13

l. *s.*
258------12
21------11
280------03 *facit*

ells *s.*
316 *at* 7 *per ell*

l. *s.*
154---16
25---16
180---12 *facit.*

ells *s.*
324 *at* 17 *per ell*

l. *s.*
259-----4
16-----4
275----8 *facit.*

14. Except when the given price of the teger is 5 *s.* for then it is ſooner anſwered taking $\frac{1}{4}$ of the given Number whoſe value ſought, as in the following Example.

$\frac{1}{4}$ | *yds.* *s.*
436 *at* 5 *per yard*
109 *l.* *facit.*

$\frac{1}{4}$ | *ells* *s.*
206 *at* 5 *per ell*
51 *l.* 10 *s.* *facit*

Case 5.

15. When the given price of an Integ is shillings and pence, or shillings, pence a Farthings; then, if the shillings and pe be an even part of a pound, divide the gi en number of integers, whose Value y seek, by the denominator of that *Fracti* representing that even part. As for Exampl what is the price of 384 *yds.* at 6 *s.* 8 *d.* p *yd.*? here I consider that 6 *s.* 8 *d.* is $\frac{1}{3}$ of pound, wherefore I divide 384 by 3 and th quote is the Answer, *viz.* 128 *l.* so that 384 *yds.* at 6 *s.* 8 *d. per yd.* amounts to 128 *l.* as *per margent*, still observing the 7*th.* Rule of th 9*th.* Chapter.

$\frac{1}{3}$	384
	138 *l. facit*

More Examples follow.

$\frac{1}{3}$	438 *ells at* 6 *s.* 8 *d.*	$\frac{1}{8}$	443 *yds.at* 2 *s.* 6 *d*
	146 *l. facit*		55 *l.* 7 *s.* 6 *d. fa*
$\frac{1}{6}$	525 *at* 3 *s.* 4 *d.*	$\frac{1}{12}$	726 *yds. at* 1 *s.* 8 *d.*
	87 *l.* 10 *s. facit*		60 *l.* 10 *s. facit*

16. Whe

16. When the given Value of the Integer shillings and pence and not an even part of pound, yet many times it may be divided into parts (*viz.* 6 *s.* 6 *d.* is 4 *s.* and 2 *s.* 6 *d.* for the 4 *s.* work according to the 12 Rule regoing, and for the 2 *s.* 6 *d.* take the eighth part of the given Number and add them together, then their sum is the value required.) So 8 *s.* 6 *d.* will be divided into 6 *s.* and *s.* 6 *d.* and the price of the given Number ay be found out as before, *&c.* Examples llow.

	yds. *s.* *d.*
	386 *at* 8 — 8
1/3	128 *l.* 13 — 4
1/10	38 — 12 — 0
	167 *l.* 5 *s.* 4 *d.* *fac.*

	ells *s.* *d.*
s.	540 *at* 5 — 4
2	54 *l.* 0 *s.*
1/6	90 —— 0
	144 *l.* 0 *s.* *facit*

	ells *s.* *d.*
s.	427 *at* 8 — 6
6	128 *l.* 2 — 0
1/8	53 —— 7 — 6
	181 *l.* 9 *s.* 6 *d.* *fac.*

	yds. *s.* *d.*
s.	386 *at* 14 — 8
8	154 *l.* 8 — 0
1/3	128 — 13 — 4
	283 *l.* 1 *s.* 4 *d.* *facit*

17. When the given price of the Integer is shillings and pence, and you cannot readily divide them according to the last

Rule, then multiply the given Numb
whoſe value you ſeek, by the number of ſhi
lings in the price of the Integer, and then fo
the pence, work by the 8*th*. Rule foregoin
then add the Numbers together, and the
Sum is the value ſought in ſhillings; as fo
Example, what is the value of 392 *yds.* a
6 *s.* 9 *d.* *per yard*? Here 6 *s.* 9 *d.* cannot b
made any even part nor indeed can it be divi
ded into even parts of a pound, wherefor
I multiply the given Number of *yards* 39
by 6, for the 6 *s.* the product is 2352 ſhil
lings, then for the 9 *d.* I divide it into 6 d
and 3 *d.* and work for them by the 8*th*. Rul
foregoing, and at laſt add the ſhillings toge
ther they make 2646 *s.* and by the 3 Rul
they are reduced to 132 *l.* 6 *s.* the value of
392 *yds.* at 6 *s.* 9 *d.* *per yard.* See the work
following.

	yds.	*s.*	*d.*
	392 *at* 6	——	9
	2352		
$\frac{1}{2}$	196		
$\frac{1}{4}$	98		
	264 | 6		
	1132 *l.* 6 *s.* *facit*		

Other Examples follow.

	l.	*s.*	*d.*
s.	480 *at*	4 ——	10
4	1920		
$\frac{1}{2}$	240		
$\frac{1}{3}$	160		
	2320|0		
	116 *l. facit*		

	ells	*s.*	*d.*
s.	732 *at*	12 ——	7
12	8784		
$\frac{1}{3}$	244		
$\frac{1}{4}$	183		
	9211|1		
	460 *l.* 11 *s. facit*		

18. When the given price of the Integer is ſhillings, pence and farthings, then multiply the given number of Integers by the number of ſhillings contained in the value of the Integer, and for the pence and farthings follow the 10*th*. Rule of this Chapter.

Examples.

	yds. s. d.
s.	438 *at* 8 — $6\frac{3}{4}$
8	3504
$\frac{1}{2}$	219
$\frac{1}{8}$	27 — $4\frac{1}{2}$ *d.*
	375|0 — $4\frac{1}{2}$
	fac. 187*l.* 10*s.* $4\frac{1}{2}$*d.*

	ells s. d.
	370 *at* 14 — $2\frac{3}{4}$
	1480
s.	370
14	5180 *d.*
$\frac{1}{6}$	61 — 8
$\frac{1}{4}$	15 — 5
$\frac{1}{2}$	7 — $8\frac{1}{2}$
	526|4 — $9\frac{1}{2}$
	fac. 263*l.* 4*s.* 9*d.* $\frac{1}{2}$

	ells s. d.
s.	136 *at* 9 — $2\frac{1}{2}$
9	1224 — 0 *d.*
$\frac{1}{6}$	22 — 8
$\frac{1}{4}$	5 — 8
	125|2 — 4
	facit 62*l.* 12*s.* 4*d.*

	ells s. d.
s.	431 *at* 2 — $4\frac{1}{2}$
2	862
$\frac{1}{4}$	107 — 9 *d.*
$\frac{1}{8}$	53 — $10\frac{1}{2}$
	102|3 — $7\frac{1}{2}$
	facit 51*l.* 3*s.* $7\frac{1}{2}$*d.*

Case 6.

19. When the given value of the Integer is pounds then multiply the Number of Integers whose value is sought by the price of the Integer, and the product is the Answer in pounds.

Examples.

Examples.

C. *l.* 42 *at* 2 *per* C. 84 *l. facit*	C. *l.* 13 *at* 8 *per* C. 104 *l. facit*
C. *l.* 30 *at* 3 *per* C. 90 *l. facit*	C. *l.* 48 *at* 12 *per* C. 576 *l. facit*

Case 7.

20. If the price of the Integer is pounds and ſhillings, then for the pounds work as in the laſt Rule, and for the ſhillings as in the 12 and 13 Rules beforegoing; then add the Numbers produced from them both, and the Sum is the Value ſought.

Examples.

	C. *l.* *s.*
	46 *at* 2----4
2 *l.*	92 *s.*
4 *s.*	9------4
	101 *l.* 4 *s. facit*

	gross *l.* *s.*
	82 *at* 4---10
4 *l.*	328
10 *s.*	41
	369 *l. facit*

	gross *l.* *s.*
	58 *at* 3----7
3 *l.*	174 *s.*
6 *s*	17------8
1 *s.*	2-----18
	194 *l.* 6 *s. facit*

	gross *l.* *s.*
	26 *at* 3---15
3 *l.*	78
14 *s.*	18-----4
1 *s.*	1-----6
	97 *l.* 10 *s. facit*

21. When the given price of an Integer consists of pounds, shillings and pence, with farthings, then work for the shillings, pence and farthings first according to the 18 Rule of this Chap. and find the total value of the given Number, as if there were no pounds, then work with the pounds according to the 19 Rule of this Chapter, and add the numbers thus found, and their Sum is the total value required.

Examples

Examples of this Rule follow.

	C.	l.	s.	d.
	213 *at*	1	13	$4\frac{1}{2}$
	639			
	213			
13 *s.*	2769			*d.*
3 *d.*	53			3
$1\frac{1}{2}$ *d.*	26			$7\frac{1}{2}$
	284|8			$10\frac{1}{2}$
1 *l.*	142 *l.* 08 *s.* $10\frac{1}{2}$ *d.*			
	213			
	355 *l.* 8 *s.* $10\frac{1}{2}$ *d.* *facit*			

C.	l.	s.	d.
37 *at*	3	8	$10\frac{1}{2}$
296 *d.*		8 *s.*	
18--6		6 *d.*	
9-3		3 *d.*	
4--$7\frac{1}{2}$		$1\frac{1}{2}$ *d.*	
32|8-$4\frac{1}{2}$			
16 *l.* 8 *s.* $4\frac{1}{2}$ *d*			
111		3 *l.*	
127 *l.* 8 *s.* $4\frac{1}{2}$ *d.* *fac.*			

	gross	l.	s.	d.
	416 *at*	2	9	$3\frac{3}{4}$
9 *s.*	3744			
3 *d.*	104			
$\frac{3}{4}$ *d.*	26			
	387|4			
	193 *l.* 14 *s.*			
2 *l.*	832			
	1025 *l.* 14 *s.* *facit*			

gross	l.	s.	d.
48 *at*	3	15	$11\frac{1}{2}$
240			
48			
720		15 *s.*	
24		6 *d.*	
16		4 *d.*	
6		$1\frac{1}{2}$ *d.*	
76|6			
38--6			
144		3 *l.*	
182 *l.* 6 *s.* *facit*			

22. When

22. When there is given the value of an Integer, and it is required to know the value of many ſuch Integers together, with $\frac{1}{4}$ or $\frac{1}{2}$ or $\frac{3}{4}$ of an integer, then firſt (by the former rules) find out the Value of the given number of Integers, and then for $\frac{1}{4}$ of an Integer take $\frac{1}{4}$ of the given value of the Integer, or for $\frac{1}{2}$, take $\frac{1}{2}$ of the given value of the Integer, and for $\frac{3}{4}$ firſt take $\frac{1}{2}$ of the given value, and then $\frac{1}{2}$ of that $\frac{1}{2}$, ſetting each part under the precedent, then adding them together, their Sum will be the required value of the Integers and their parts. Example; what is the value of 116 $\frac{1}{2}$ *yds.* at 4 *s.* 6 *d. per yard*? To give an Anſwer, firſt I work for the value of 116 *yds.* by the 15*th* rule foregoing, and then for the $\frac{1}{2}$ yard I take $\frac{1}{2}$ of 4 *s.* 6 *d.* which is 2 *s.* 3 *d.* and add to the reſt found as before, then is that Sum the total value of 116 $\frac{1}{2}$ *yds.* at 4 *s.* 6 *d. per yard*, which I find to amount to 26 *l.* 04 *s.* 3 *d* as by the work in the Margent.

yds.	*s.*	*d.*
116 $\frac{1}{2}$ *at*	4 —	6
11 *l.* 12 *s.*		2 *s.*
14--10 *d.*		2 *s.* 6 *d*
2--3		$\frac{1}{2}$ *yd.*
26-04--3 *facit*		

Other

Other Examples follow.

$324\frac{1}{4}$ yds. at 4 s. 10 d.

1296	4 *s.*
162	6 *d.*
108	4 *d.*
1—$2\frac{1}{2}$ *d.*	$\frac{1}{4}$ *yd.*

156|7 *s.*——$2\frac{1}{2}$ *d.*

78 *l.* 7 *s.* $2\frac{1}{2}$ *d. facit*

$720\frac{1}{2}$ yds. at 6 s. 8 d.

240 *l.* 3 *s.* 4 *d. facit*

$228\frac{3}{4}$ ells at 12 s 11 d.

2736	12 *s.*
76	4 *d.*
76	4 *d.*
57	3 *d.*
6—$5\frac{1}{2}$ *d.*	$\frac{1}{2}$ *ell.*
3—$2\frac{3}{4}$ *d.*	$\frac{1}{4}$ *ell.*

295|4—$8\frac{1}{4}$ *d.*

147 *l.* 14 *s* $8\frac{1}{4}$ *d. fac.*

C. *qrs. l.*   *l. s.*
28--3--14 *at* 1-10 *per* C.

28 *l.*	1 *l.*
14 *l.*	10 *s.*
00--15 *s.*	$\frac{1}{2}$ C.
7 *s.* 6 *d.*	$\frac{1}{4}$ C.
3 *s.* 9 *d.*	14 *l.*

43 *l.* 6 *s.* 3 *d. facit*

Many more questions may be stated, and several other Rules of Practice may be shewn according to the method of divers Authors, but what have been delivered here are sufficient for the practical Arithmetician in all Cases whatsoever.

CHAP.

CHAP. XXVII.

The Rule of Barter.

1. Barter is a Rule amongſt Merchants, which (in the Exchanging of one Commodity for another) informs them ſo to proportion their Rates as that neither may ſuſtain loſs.

2. To reſolve queſtions in *Barter*, it will not be difficult to him that is acquainted with the Golden Rule, or Rule of 3, it being altogether uſed in reſolving ſuch queſtions.

Queſt. 1. Two Merchants (*viz.* A and B) *barter*, A hath 13 *C.* 3 *qrs.* 14 *l.* of Pepper at 2 *l.* 16 *s. per C.* and B hath Cotton at 9 *d. per l.* I demand how much Cotton B muſt give A for his Pepper?

Anſwer, 9 *C.* 1 *qr.*

Firſt, find by the Rule of 3, or the Rules of Practice foregoing, how much the Pepper is worth, ſaying,

If 1 *C.* coſt 2 *l.* 16 *s.* what will 13 *C.* 3 *qrs.* 14 *l.* coſt?

Anſwer, 38 *l.* 17 *s.*

Secondly,

Secondly, by the Rule of 3 say, if 9 *d.* buy 1 *l.* of Cotton, how much will 38 *l.* 17 *s.* buy?

Answer, $9\frac{1}{4}$ *C.* and so much Cotton must B give to A for 13 *C.* 3 *qrs.* 14 *l.* of Pepper at 2 *l.* 16 *s. per Cent.* when the Cotton is worth 9 *d. per l.*

Quest. 2. Two Merchants (A and B) *barter*, A hath Ginger worth 1 *l.* 17 *s.* 4 *d. per C.* but in *barter* he will have 2 *l.* 16 *s. per C.* B hath Nutmegs worth 5 *l.* 12 *s. per C.* now I demand how B must rate his Nutmegs *per C.* to make his gain in *barter* equal to that of A?

Answer 8 *l.* 8 *s.*

Say, by the Rule of 3, if 1 *l.* 17 *s.* 4 *d.* require 2 *l.* 16 *s.* in *barter*, what will 5 *l.* 12 *s.* require in *barter*?

Facit 8 *l.* 8 *s.*

Quest. 3. A and B *barter*, A hath 120 *yds.* of Broad-cloth worth 6 *s. per yd.* but in *barter* he will have 8 *s. per yd.* B hath shalloon worth 4 *s. per yd.* Now I demand how many *yds.* of shalloon B must give A for his broad-cloth, making his gain in *barter* equal to that of A?

Answer, 180 yds. of shalloon.

First (as in the last question) find out how B ought to sell his shalloon in *barter*, *viz.* say, if 6 *s.* require 8 *s.* what will 4 *s.* require?

Answer,

Answer, 5 *s.* 4 *d.*

Thus you see that B must sell his shalloon in *barter* at 5 *s.* 4 *d.* if A sell his broad-cloth at 8 *s. per* yard.

It remaineth now to find how much shalloon B must give for 120 yards of broad-cloth, which, after the same method used to resolve the first question of this Chapter, is found to be 180; and so many *yds.* of shalloon must B give A for the 120 *yds.* of broad-cloth.

Quest. 4. A and B *bartered*, A had 14 *C.* of Sugar worth 6 *d. per l.* for which B gave him 1 *C.* 3 *qrs.* of Cinamon, I demand how B rated his Cinamon *per l.*?

Answer, 4 *s. per* pound.

Quest. 5. A and B *barter*, A hath 4 Tun of Brandy worth 37 *l.* 16 *s.* ready money, but in *barter* he hath 50 *l.* 8 *s. per* Tun, and A giveth B 21 *C.* 2 *qrs* 11 $\frac{1}{5}$ *l.* of Ginger for his 4 Tun of Brandy, I desire to know how B sold his Ginger in *barter per C.* and how much it was worth in ready money?

Answer, For 9 *l.* 6 *s.* 8 *d.* in *barter*, and it was worth 7 *l. per C.* in ready money.

Qu. 6. A and B *barter*, A hath 320 dozen of Candles at 4 *s.* 6 *d. per* dozen, for which B giveth him 30 *l.* in money, and the rest in Cotton at 8 *d. per l.* I demand how much Cotton he must give him more than the 30 *l.*?

Answer,

Answer, 11 *C.* 1 *qr.*

Quest. 7. A and B *barter*, A hath 608 yards of broad cloth worth 14 *s. per yd.* for which B giveth him 125 *l.* 12 *s.* ready money, and 85 *C.* 2 *qrs.* 24 *l.* of Bees Wax, now I desire to know how he reckoned his Wax *per C.*?

Answer, 3 *l.* 10 *s. per C.*

CHAP. XXVIII.

Questions in Loss and Gain.

Quest. 1. A Merchant bought 436 yards of broad-cloth for 8 *s.* 6 *d. per yd.* and selleth it again at 10 *s.* 4 *d. per yd.* now I desire to know how much he gained in the sale of the 436 yards?

Answer, 39 *l.* 19 *s.* 4 *d.*

First find out by the Rule of Three, or by Practice

Practice how much the Cloth cost him at 8 *s.* 6 *d. per yd.* which I find to be 185 *l.* 6 *s.* then by the same Rule find out how much he sold it for, *viz.* 225 *l.* 5 *s.* 4 *d.* then subtract 185 *l.* 6 *s.* which it cost him, from 225 *l.* 5 *s.* 4 *d.* which he sold it for, and there remaineth 39 *l.* 19 *s.* 4 *d.* for his gain in the sale thereof.

Otherwise it may sooner be resolved thus, first find out how much he gained *per yd. viz.* subtract 8 *s.* 6 *d.* which he gave *per yd.* from 10 *s.* 4 *d.* which he sold it for *per yd* the remainder is 1 *s.* 10 *d.* for his gains *per yd.* then say,

If 1 *yd.* gain 1 *s.* 10 *d.* what will 436 *yds.* gain? the *Answ.* by Practice, or the Rule of three, is 39 *l.* 19 *s.* 4 *d.* as was found before.

Quest. 2. A Draper bought 124 *yds.* of Holland cloth, for which he gave 31 *l.* I desire to know how he must sell it *per yd.* to gain 10 *l.* 6 *s.* 8 *d.* in the whole sale of the 124 *yds.*? Answer, at 6 *s.* 8 *d. per yd.*

Add the price which it cost him (*viz.* 31 *l.*) to his intended gain (*viz.* 10 *l.* 6 *s.* 8 *d.*) the sum is 41 *l.* 6 *s.* 8 *d.* then say,

If 1 *yds.* require 41 *l.* 6 *s.* 8 *d.* what will 1 *yd.* require? by the Rule of Three I find the Answer 6 *s.* 8 *d.*

Quest. 3. A Grocer bought 3 *C.* 1 *qr.* 14 *l.* of Cloves, which cost him 2 *s.* 4 *d. per l.* and sold them for 52 *l.* 14 *s.* I desire to know

know how much he gained in the whole? Answer 8 *l.* 12 *s.*

Quest. 4. A *Draper* bought 86 Kerseys for 129 *l.* I demand how he must sell them *per* piece to gain 15 *l.* in laying out 100 *l.* at that rate? Ans. 1 *l.* 14 *s.* 6 *d. per* piece; for,

As 100 *l.* is to 115 *l.* so is 129 *l.* to 148 *l.* 7 *s.*

So that by the proportion above, I have found how much he must receive for the 86 Kerseys to gain after the rate of 15 *l. per C.* then to find how he must sell them *per* piece. I say,

As 86 pieces are to 148 *l.* 7 *s.* so is 1 piece to 1 *l.* 14 *s.* 6 *d.* which is the number sought.

Quest. 5. A *Grocer* bought $4\frac{1}{4}$ *C.* of Pepper for 15 *l.* 17 *s.* 4 *d.* and (it proving to be damnified) is willing to lose 12 *l.* 10 *s. per Cent.* I demand how he must sell it *per l.*? Answer 7 *d. per l.*

Subtract 12 *l.* 10 *s.* the loss of 100 *l.* from 100 *l.* and there remains 87 *l.* 10 *s.* then say,

As 100 *l.* is to 87 *l.* 10 *s.* so is 15 *l.* 17 *s.* 4 *d.* to 13 *l.* 17 *s.* 8 *d.* so much as he must sell it all for to lose after the rate propounded: then to know how he must sell it *per l.* I say,

As 13 *l.* 17 *s.* 6 *d.* is to $4\frac{1}{4}$ *C.* so is 1 *l.* to 7 *d.*

Quest.

Quest. 6. A *Plummer* ſold 10 Fodder of Lead, the *fodder* containing $19\frac{1}{2}$ C.) for 204 *l.* 15 *s.* and gained after the rate of 12 *l.* 10 *s.* *per* 100 *l.* I demand how much it coſt him *per C.*? Anſwer 18 *s.* 8 *d.*

To reſolve this Queſtion add 12 *l.* 10 *s.* (the Gain *per Cent.*) to 100 *l.* and it makes 112 *l.* 10 *s.* then ſay,

As 112 *l.* 10 *s.* is to 100 *l.* ſo is 204 *l.* 15 *s.* to 182 *l.*

Which 182 *l.* is the Sum it coſt him in all, then reduce your 10 *fodders* to half hundreds and it makes 390, then ſay,

As 390 half hundreds is to 182 *l.* ſo is 2 half hundreds to 18 *s.* 8 *d.* the price of 2 half hundreds, or one *C.* weight, and ſo much it ſtood him in *per C.* weight.

Queſt. 7. A Merchant bought 8 Tuns of Wine, which being ſophiſticated he ſelleth for 400 *l.* and looſeth after the rate of 12 *l.* in receiving 100 *l.* now I demand how much it coſt him *per tun*? and how he ſelleth it *per gall.* to loſe after the ſaid rate? Anſw. it coſt 56 *l.* *per tun*, and he muſt ſell it at 3 *s.* 11 *d.* $2\frac{10}{21}$ *qrs.* *per gallon* to loſe 12 *l.* in receiving 100 *l.*

To reſolve this queſtion I conſider in the firſt place, that in receiving 100 *l.* he loſeth 12 *l.* therefore 100 comes in, for 112 *l.* laid out, wherefore to find how much he laid out for the whole, I ſay,

As

As 100 *l.* is to 112, so is 400 *l.* to 448 *l.* and so much the 8 Tun cost him, then to find how much it cost *per tun*, I say,

As 8 is to 448 *l.* so is 1 to 56 *l.* the price it cost *per Tun.*

Now to find how he must sell it *per gall.* reduce the 8 *Tuns* into Gallons, they make 2016, then say,

As 2016 Gall. is to 400 *l.* so is one Gall. to 3 *s.* 11 *d.* 2 $\frac{10}{21}$ *qrs.* the price he must sell it at *per gall.* to lose as aforesaid.

Quest. 8. A *Merchant* bought 8 *Tuns* of Wine, which being sophisticated he is willing to sell for 400 *l.* and loseth at that rate 12 *l.* in laying out 100 *l.* upon the same, now I demand how much it cost him *per Tun*?

Here I consider, that for 100 *l.* laid out, he receiveth but 88 *l.* therefore to find what the 8 Tuns cost him, I say,

As 88 *l.* is to 100 *l.* so is 400 *l.* to 454 $\frac{6}{11}$ the price it all cost him, then to find how much *per tun*, I say,

As 8 is to 454 $\frac{6}{11}$ *l.* so is 1 to 56 $\frac{9}{11}$, or 56 *l.* 16 *s.* 4 *d.* 1 $\frac{5}{11}$ *qr.* *per Tun.*

CHAP.

CHAP. XXIX.

Equation of Payments.

1. EQuation of Payments, is that Rule amongst Merchants whereby we reduce the times for payment of several Sums of Money, to an equated time for the payment of the whole debt, without Damage, to Debtor or Creditor, and

The Rule is,

2. Multiply the Sums of each particular payment by its respective Time, then add the several products together, and their Sum divide by the total debt, and the quotient thence arising is the equated Time for the payment of the whole debt. Example.

Quest.

Quest. 1. A is indebted to B in the Sum of 130 *l.* whereof 50 *l.* is to be paid at 2 months,and 50 *l.* at 4 months, and the rest at 6 months, now they agrée to make one payment of the total Sum, the question is what is the equated time for Payment without Damage to Debtor or Creditor?

To resolve this question I multiply each payment by its time,*viz.*

50 *l. multiplyed by* 2 *months produceth*	100
50 *l. multiplyed by* 4 *months produceth*	200
30 *l. multiplyed by* 6 *months produceth*	180
The Sum of the Product is	480

Then I divide 480 (the Sum of the Products) by 130 (the total debt) and the quotient is $3\frac{9}{13}$ months for the time of paying the whole debt.

*Qu.*2. A *Merchant* hath owing him 1000*l.* to be paid as followeth,*viz.* 600 *l.* at 4 months, 200 *l.* at 6 months, and the rest (which is 200 *l.*) at 12 months; and he agreeth with his Debtor to make one payment of the whole, I demand the time of Payment without Damage to Debtor or Creditor?

600 *l. multiplied by* 4 *months is*	2400
200 *l. multiplied by* 6 *months is*	1200
200 *l. multiplied by* 12 *months is*	2400
The Sum of the product is	6000

and

and the ſum of the products (6000) being divided by the whole debt (1000 *l.*) quotes 6 *mon.* for the time of payment of the whole debt.

3. The truth of this Rule is thus manifeſt, if the intereſt of that money which is paid (by the equated time) after it is due, be equal to the intereſt of that money which (by the equated time) is paid ſo much ſooner than it is due at any rate *per C.* then the operation is true; otherwiſe not.

The Proof of the Rule of Equation of Payments.

Example. In the laſt queſtion 600 *l.* ſhould have been paid at 4 months but it is not diſcharged till 6 months (that is 2 months after it is due) wherefore its intereſt for 2 months at 6 *per C. per annum* is 6 *l.* and then 200 *l.* was to be paid at 6 months which is the equated time for its payment, therefore no intereſt is reckoned for it, but 200 *l.* ſhould have been paid at 12 mon. but it is to be paid at 6 months, which is 6 months ſooner than it ought, wherefore the intereſt of 200 *l.* for 6 months is 6 *l.* (accompting 6 *l. per Cent. per annum*) which is equal to the intereſt of 600 *l.* for 2 months, wherefore the work is right.

Queſt. 3. A *Merchant* hath owing him a certain ſum to be diſcharged at 3 equal payments, *viz.* $\frac{1}{3}$ at two months, $\frac{1}{3}$ at four mon.

mon.and $\frac{1}{3}$ at 8 mon.the queſtion is, what is the equated time for the payment of the whole debt?

In queſtions of this nature (*viz.* where the debt is divided into equal or unequal parts) each of the parts is to be multiplied by its time, and the ſum of the product is the Anſwer,

$\frac{1}{3}$ *multiplied by* 2 *mon. produceth* $\frac{2}{3}$
$\frac{1}{3}$ *multiplied by* 4 *mon. produceth* $1\frac{1}{3}$
$\frac{1}{3}$ *multiplied by* 8 *mon. produceth* $2\frac{2}{3}$

The Sum of the Product is $4\frac{2}{3}$

which is $4\frac{2}{3}$ months for the equated time of payment.

If inſtead of the *fractions* (repreſenting the parts) you had wrought by the numbers themſelves (repreſented by thoſe parts) according to the firſt and ſecond Examples, it would have been the ſame Anſwer, as ſuppoſe the debt had been 90 *l.* then $\frac{1}{3}$ of it is 30 *l.* for each payment, *viz.* at 2, 4, and 8 months, then

30 *l. multiplied by* 2 *mon. produceth* 60
30 *l. multiplied by* 4 *mon. produceth* 120
30 *l. multiplied by* 8 *mon. produceth* 240

The Sum of the product is 420

which divided by 90 (the whole debt) quoteth $4\frac{60}{90}$ or $4\frac{2}{3}$ months as before.

Quest. 4. A Merchant oweth a Sum of money to be paid $\frac{1}{2}$ at 5 Months, and $\frac{1}{4}$ at 8 Months, and $\frac{1}{4}$ at 10 Months, and he agreeth with his Creditor to make one total payment; I demand the time, without damage to Debtor or Creditor? Work as in the last Question, and you will find the Answer to be 7 Months.

Quest. 5. *A* is indebted to *B* 640 *l.* whereof he is to pay 40 *l.* present money, and 350 *l.* at 3 Months, and the rest (*viz.* 250 *l*) at 8 Months, and they agree to make an Equated time for the whole Payment, now I demand the time?

In questions of this Nature (*viz.* where there is ready money paid) you are (in Multiplying) to neglect the money that is to be paid present, and work with the rest as is before directed, and divide the Sum of the products by the whole Debt, and the Quote is the Answer: For here 40 *l.* is to be paid present, and hath no time allowed, and according to the Rule it should be multiplied by its time, which is (0) therefore 40 times 0 is 0, which neither augmenteth nor diminisheth the Dividend; wherefore (to proceed according to direction) I say,

350 *by* 3 *Months produceth* —— 1050
250 *by* 8 *Months produceth* —— 2000

The Sum of the Product is —— 3050

which Divided by 640, the whole Debt, the Quote is $4\frac{49}{64}$ Months, the time of Payment.

Quest. 6. *A* is indebted to *B* in a certain Sum, $\frac{1}{2}$ whereof is to be paid present money, $\frac{1}{3}$ at 6 Months, and the rest at 8 Months; now I demand the Equated time for the payment of it all?

Answer, $3\frac{1}{3}$ Months is the time of payment.

Quest. 7. *A* is indebted to *B* 120 *l.* whereof $\frac{1}{2}$ is to be paid at 3 months, $\frac{1}{4}$ at 6 months, and the rest at 9 months; what is the Equated time for the payment of the whole Sum?

Answer, At $6\frac{1}{4}$ months.

Quest. 8. *A* is indebted to *B* 420 *l.* which is due at the end of 6 months, but *A* is willing to pay him 140 *l.* present, provided he can have the remainder forborn so much the longer to make Satisfaction for his kindness, which is agreed upon, I desire to know what time ought to be allotted for the payment of the 280 *l.* remaining?

To resolve this Question, first, find out what is the interest of 140 *l.* for the time it was paid before it was due, at 6 *per Cent.*

(or any other rate) (*viz.* 6 months) and you will find it to be 4 *l.* 4 *s.* Then it is evident that the remaining 280 *l.* muſt be detained ſo much longer than 6 mon. as the while it may eat out that intereſt, *viz.* 4 *l.* 4 *s.* which is thus found out, *viz.* Firſt, ſee what is the Intereſt of 280 *l.* for a month, or any other time; but here we will take one month, and its Intereſt, for one month is 28 *s.*

Then by the Rule of Three, ſay,

As 28 *s.* is to 1 month, ſo is 84 *s.* to 3 months; ſo that the 280 *l.* remaining muſt be kept 3 months beyond its firſt time of payment, (*viz.* 6 months) which added thereto, makes 9 months, at the end of which time *A* ought to make payment of the remainder.

CHAP.

CHAP. XXX.

Exchange.

1. THE Rule of Exchange informeth Merchants how to exchange Moneys, Weights, or Measures of one Country into (or for) the Moneys, Weights, or Measures of another Country, and when the Rate, Reason or Proportion betwixt the Money, Weights, or Measures of different Countreys is known, it will not be difficult for the Practitioner that is well acquainted with the Rule of Proportion (or Rule of Three) to solve any question wherein it is required to Exchange a given quantity of the one kind, into the same value of another kind.

2. In Questions of Exchange, there is always a Comparison made between the Coyns, &c. of two Countries (or kinds) or of more.

3. In Questions where there is a Comparison made between two things, (whether they be Moneys, Weights, &c.) of

different kinds or (Countries) there may be a solution found by a single Rule of 3, as may appear by the following Example.

Quest. 1. A Merchant at *London* delivered 370*l. Sterling*, to receive the same at *Paris* in *French* Crowns, the Exchange $3\frac{1}{3}$ *French* Crowns *per* pound *Sterling*. I demand how many *French* Crowns ought he to receive?

In placing the numbers observe the 6 Rule of the 10 Chapter, which being done the given numbers will stand thus,

l.	Crowns	l.
1 ———	$3\frac{1}{3}$ ———	370

and being reduced according to the Rules of the 24 Chapter, will stand thus;

$$\begin{array}{cccccccc} & \text{l.} & & \text{Crowns} & & \text{l.} & & \text{Crowns} \\ \text{As} & \frac{1}{1} & \text{is to} & \frac{10}{3} & \text{so is} & \frac{370}{1} & \text{to} & 1233\frac{1}{3} \end{array}$$

So that I conclude he ought to receive $1233\frac{1}{3}$ *French* Crowns at *Paris* for his 370 *l.* delivered at *London*.

Quest. 2. A Merchant delivered at *Amsterdam* 587*l. Flemish* to receive the value thereof at *Naples* in Ducats the exchange $4\frac{4}{5}$ Ducats *per l. Flemish*. I demand how many Ducats he ought to receive?

The proportion is as followeth.

$$\begin{array}{cccccccc} & \text{l.} & & \text{Ducats} & & \text{l.} & & \text{Ducats} \\ \text{As} & \frac{1}{1} & \text{is to} & \frac{24}{5} & \text{so is} & \frac{587}{1} & \text{to} & 2817\frac{3}{5} \end{array}$$

So I find he ought to receive $2817\frac{3}{5}$ Ducats at *Naples*

Naples for the 587 *l. Flemish* delivered at *Amsterdam.*

Quest. 3. A Merchant at *Florence* delivereth 3478 Ducatoons, to receive the value at *London* in Pence the exchange $53\frac{1}{2}$ pence *Sterling per* Ducatoon; I demand how much *Sterling* he ought to receive?

The Proportion for Resolution is,

$$\text{As } \overset{\text{Duc.}}{\tfrac{1}{1}} \text{ is to } \overset{\text{d.}}{\tfrac{107}{2}} \text{ so is } \overset{\text{Duc.}}{\tfrac{3478}{1}} \text{ to } \overset{\text{d.}}{186073}$$

which is equal to 775 *l.* $6\frac{1}{12}$ for the Answer.

I might here (according to the Custom of Arithmetical Writers lay down Tables for the Reduction of Foreign Coyns to *English*; but by Reason of their Instability (for they continue not at a constant standard, as our *Sterling* money doth, but are sometimes raised and sometimes depressed) I shall forbear.

4. When there is a Comparison made between more than two different Coyns, Weights, or Measures, there ariseth ordinarily two different cases from such a Comparison.

1. When it is required to know how many pieces of the first Coyn, Weight, or Measure are equal in value to a known number of Pieces of the last Coyn, Weight, or Measure.

2. When it is Required to find out how many Pieces of the last Coyn, Weight, or Measure are equal in Value to a given number of the first sort of Coyn, Weight, or Measure.

An Example of the first Case may be this, VIZ.

Quest. 4. If 150 pence at *London* are equal to 3 Ducats at *Naples*, and $4\frac{4}{5}$ Ducats at *Naples* make $34\frac{1}{2}$ Shillings at *Brussells*, then how many pence at *London* are equal to 138 Shillings at *Brussels*? *Facit* 960 *d.*

This Question may be resoved at two single Rules of Three; for first I say,

If $\frac{3}{1}$ Ducats at *Naples* make 150 Pence at *London*, how many Pence will $4\frac{4}{5}$ Ducats make?

Answer, 240 Pence.

By the fore-going Proportion, we have discovered that $4\frac{4}{5}$ Ducats at *Naples* make 240 pence at *London*: And by the Tenour of the Question we see that $4\frac{4}{5}$ Ducats at *Venice* make $34\frac{1}{2}$ shillings at *Brussels*, therefore 240 pence at *London* are equal to $34\frac{1}{2}$ shillings at *Brussels*, (for the things that are equal to one and the same thing are also equal to one another) wherefore we have a Way laid open to give a solution to this

Question

Question by another Single Rule of Three, whose Proportion is,

As 34 ½ shillings at *Brussels* is to 240 pence at *London*; so is 138 shillings at *Brussels* to 960 pence at *London*, which is the Answer to the Question.

An Example of the Second Case may be thus, VIZ.

Quest. 5. If 40 *l. Averdupois* weight at *London* is equal to 36 *l.* weight at *Amsterdam*; and 90 *l.* at *Amsterdam* makes 116 *l.* at *Dantzick*; then how many pounds at *Dantzick* are equal to 112 *l.* of *Averdupois* weight at *London?*

Answer, 129 $\frac{23}{25}$ pounds at *Dantzick*.

This Question is likewise answered at two single Rules of Three, *viz*. First, I say,

As 36 *l.* at *Amsterdam* is to 40 *l.* at *Lond.*
So is 90 *l.* at *Amsterdam* to 100 *l* at *Lond.*

And by the Question you find that 90 *l.* at *Amsterdam* is 116 *l.* at *Dantzick*; and therefore 100 *l.* at *London* is likewise equal thereunto, wherefore again I say,

As 100 *l.* at *Lond.* is to 116 *l.* at *Dant.*
So is 112 *l.* at *Lond.* to 129 $\frac{23}{25}$ at *Dant.*

By which I find that 112 $\frac{23}{25}$ *l.* at *Dant.* are equal to 112 *l. Averdupois* weight at *Lond.*

5. There is a more ſpeedy way to Reſolve ſuch Queſtions as are contained under the two Caſes before mentioned, laid down by Mr. *Kerſey* in the third Chapter of his Appendix to Mr. *Wingate*'s Arithmetick, where he hath given two Rules for the Reſolution of the Queſtions pertinent to the two ſaid Caſes.

6. But I ſhall lay down a general Rule for the ſolution of both Caſes; and firſt, let the Learner obſerve the following Directions in placing of the given terms, *viz.*

7. Let there be made two Columns, and in theſe Columns ſo place the given terms one over the other, as that in the ſame Column there may not be found two Terms of the ſame kind one with the other.

Having thus placed the Terms, the General Rule is,

Obſerve which of the ſaid Columns hath the moſt Terms placed in it, and multiply all the Terms therein continually, and place the laſt Product for a Dividend; then multiply the Terms in the other Column continually, and let the laſt product be a Diviſor; then divide the ſaid Dividend by the ſaid Diviſor, and the Quotient thence ariſing is the Anſwer to the queſtion.

So the example of the firſt of the ſaid caſes being again repeated, *viz.* if 150 pence at *London* make 3 Ducats at *Naples*, and 4½ ducats

ducats at *Naples* make 34 $\frac{1}{2}$ ſhill. at *Bruſſels*, then how many Pence at *London* are equal to 138 ſhillings at *Bruſſels*?

The terms being placed according to the 7*th*. Rule will ſtand as followeth.

	A	B	
Pence at Lond.	150	3	*Ducats at Na.*
Ducats at Na.	$4\frac{4}{5}$	$34\frac{1}{2}$	*Shill. at Bruſſ.*
Shill. at Bruſſ.	138		

having thus placed the terms that in neither column there is two terms of one kind, then obſerve that the column under A hath moſt terms in it, therefore they muſt be multiplied together for a dividend; *viz.* 150 mult. by $4\frac{4}{5}$ produceth $\frac{3600}{5}$ which multiplied by 138 produceth $\frac{496800}{5}$ for a dividend, then in the column under B there are 3 and $34\frac{1}{2}$ which multiplied together produce $\frac{207}{2}$ for a diviſor; then having divided $\frac{496800}{5}$ by $\frac{207}{2}$ the quotient is 960 pence for the anſwer as before.

Again, let the example of the ſecond caſe be again repeated, *viz.* If 40 *l.* Averdupois weight at *London* make 36 *l.* weight at *Amſterdam*, and 90 *l.* at *Amſterdam* make 116 *l.* at *Dantzick*, then how many pounds at *Dantzick* are equal to 112 *l.* *Averdupois* weight at *London*?

The

The terms being disposed according to the 7*th*. Rule foregoing will stand thus,

	A	B	
l. at Lond.	40	36	*l. at Amsterdam.*
l. at Amst.	90	116	*l. at Dantzick.*
		112	*l. at London.*

whereby I find that the terms under B multiplied together produce 467712 for a dividend, and the terms under A *viz.* 40 and 90 produce 3600 for a divisor, and division being finished the quotient giveth $129\frac{3312}{3600}$ pounds at *Dantzick* for the Answer.

CHAP. XXXI.

Single Position.

1. NEgative Arithmetick, called the Rule of False, is that by which we find out a truth, by numbers invented or supposed, and this is either single or double.

2. The Rule of Single Position is when at once, *viz.* by one False position, or feigned number, we find out the true Number sought.

3. In the single Rule of False, when you have made choice of your position, work it

according

according to the tenour of the question, as if it were the true number ſought, and if by the ordering of your poſition you find the reſult either too much or too little you may then find out the number ſought by this proportion following, *viz.*

As the reſult of your poſition is to the poſition, ſo is the given number to the number ſought.

Example.

Queſt. 1. A Perſon having about him a certain number of Crowns, ſaid if the fourth and third and ſixth of them were added together they would make juſt 45, now I demand the number of Crowns he had about him? *Anſwer* 60 Crowns.

To reſolve this queſtion I ſuppoſe he had 24 Crowns (or any other number that will admit of the like diviſion) now the fourth of 24 is 6, and the third is 8, and the ſixth is 4, all which parts (*viz.* 6, 8, and 4) being added together make but 18, but it ſhould be 45, wherefore I ſay by the Rule of three.

As 18, the ſum of the parts, is to the poſition 24, ſo is 45 the given number to 60 the true number ſought.

For the fourth of 60 is 15, and the third of 60 is 20, and the ſixth of 60 is 10, which added together make 45.

Queſt. 2. Three Perſons, *viz.* A, B, C, thus diſcourſe

diſcourſe together concerning their Age, quoth B to A, I am as old, and half as old again as you, then quoth C to B I am twice as old as you, then quoth A to them and I am ſure the Sum of all our Ages is 165, now I demand each mans Age? *Anſwer*, A 30, B 45, C 90 years of Age, which added together makes 165.

CHAP. XXXII.

Double Poſition.

1. THE Rule of Double Poſition is when 2 Falſe poſitions are aſſumed, to give a Reſolution to the queſtion propounded.

2. When any Queſtion is ſtated in double poſition, make ſuch a croſs as followeth.

a X *b*
d   *c*

3. Then make choice of any number you think may be convenient for your working, which call your firſt Poſition, and place it at that end of the Croſs at *a*, then work with this poſition (as if it were the true number ſought

ſought)according to the nature of your queſtion, then having found out your errour, either too much or too little, place it on that ſide the croſs *d*, then make choice of another number of the ſame denomination with the firſt poſition(which call your ſecond *poſition*)and place it on that ſide of the croſs at *b*, then work with this *poſition* as with the former, and having found out your error, either too much or too little, place it on that ſide of the croſs at *c*, and then the poſitions will ſtand at the top of the croſs, and the errors at the bottom each under his correſpondent *poſition*, and then multiply the errors into the *poſitions* croſs-wiſe, that is to ſay multiply the firſt *poſition* by the ſecond error, and the ſecond *poſition* by the firſt error, and put each product over its *poſition*.

4. Having proceeded ſo far then conſider whether the errors were both alike, that is, whether they were both too much, or both too little, and if they are alike, then ſubtract the leſſer product from the greater, and ſet the remainder for a dividend, then ſubtract the leſſer Error from the greater, and let the remainder be a diviſor, then the quotient ariſing by this diviſion is the anſwer to the queſtion.

5. But if the errors are unlike, that is,

one too much and the other too little, then add the products of the *positions* and errors together, and their Sum ſhall be a dividend, then add the *errors* together, and their Sum ſhall be a Diviſor, and the Quotient ariſing hence is the Anſwer; which two laſt Rules may be kept in memory by this verſe following, *viz.*

When Errors are of unlike kinds
Addition *doth enſue*,
But if alike, Subtraction *finds*
Dividing work for you.

Queſt. 1. A, B, and C build a Houſe which coſt 76 *l.* of which A paid a certain Sum unknown, B paid as much as A and 10 *l.* over, and C paid as much as A and B, now I deſire to know each mans Share in that Charge?

Having made a Croſs according to the 2 Rule, I come according to the third Rule to make choice of my firſt poſition, and here I ſuppoſe A paid 6 *l.* which I put upon the Croſs as you ſee, then B paid 16 *l.* (for it is ſaid he paid 10 *l.* more than A) and C paid 22 *l.* for 'tis ſaid he paid as much as A and B, then I add their parts.

l.					*l.*
9				A	6
19				B	16
28	120	168	288	C	22
—	6	X	9		—
56	12)		(14	*Sum*	44
	32		20		
76		12			76
56					44
—					—
20				*error*	32

and they amount to 44, but it is ſaid they paid 76 *l.* wherefore it is 32 too little, which I note down at the bottom of the Croſs under its poſition for the firſt error.

Secondly, I ſuppoſe A paid 9 *l.* then B paid 19 *l.* and C 28 *l.* all which added together make 56, but they ſhould make 76, wherefore the error of this poſition is 20 which I put at the bottom of the Croſs under his poſition for the ſecond *Error*, then I multiply the *Errors* and the *Poſitions* Croſs-wiſe, *viz.* 32 (the *Error* of the firſt *Poſition*) by 9 (the ſecond poſition) and the product is 288. Then I multiply 20 (the *Error* of the ſecond *Poſition*) by 6 (the firſt *Poſition*) and the Product is 120.

Then (according to the 4*th.* Rule) I ſubtract the leſſer Product from the greater, (*viz.* 120 from 288, becauſe the *Errors* are both

both alike *viz.* too little) and there remaineth 168 for a dividend, then I ſubſtract 20 (the leſſer *Error*) from 32 (the greater *Error*) and the remainder is 12 for a Diviſor, then divide 168 by 12 and the Quotient is 14 for the Anſwer, which is the ſhare of A in the Payment.

6. Again Secondly, If the errors had been both too bigg it had had the ſame effect, as appeareth by the following work; for firſt I ſuppoſe A paid 20 *l.* then B paid 30 *l.* and C 50 *l.* which in all is 100, but it ſhould have been no more than 76, wherefore the firſt *Error* is 24 too much. Again I ſuppoſe A paid 18 *l.* then B muſt pay 28 *l.* and C muſt pay 46 *l.* which in all

20 A				A 18
30 B				B 28
50 C	320	112	432	C 46
	20	X	18	
100 *ſum*	8)		(14 *facit*	*ſum* 92
76 *ſubtr.*	24		16	*ſubtr.* 76
		8		
24 *error*				*error* 16

is 92 *l.* but it ſhould have been but 76 *l.* wherefore the ſecond *Error* is 16 too much; then I multiply 20 (the firſt *Poſition*) by 16 (the ſecond *Error*) and the Product is 320, again I multiply 18 (the ſecond *Poſition*) by 24 (the firſt *Error*) and the product is 432.

Then

Then because the *Errors* are both too much, I subtract 320 (the lesser product) from 432 (the greater product) and there Remaineth 112 for a Dividend, likewise I substract (16 the lesser *Error*) from 24 (the greater *Error*) and the difference is 8 for a Divisor, then perform Division, and the Quotient is 14 (as before) for the answer.

Again Thirdly, If the *Errors* had been the one too bigg, and the other too little, Respect being had to the 5*th*. Rule foregoing, the Answer would have been the same; as thus, I take for my first *Position* 6, and then the *error* is 32 too little, then I take for my second *Position* 18, and then the *error* is 16 too much, then I multiply the Positions and *errors* Cross-wise, and the products are 96 and 576, and because the *errors* are unlike,

96	672	576
6	X	18
48)		(14
32		16
	48	

(*viz.*) one too bigg, and another too little, I add the products 96 and 5 6 together and their Sum is 672 for a Dividend, I likewise add the *errors* 32 and 16 together, and their sum is 48 for a Divisor, then having finished Division, I find the Quotient to be 14 which

is

is the answer as was found out at the 2 several Tryals before.

For proof of the Work I say,

	l.
If A *paid* ———————	14
Then B *paid* 14 *and* 10 (*that is*) ——	24
Then C *paid* 14 *and* 24 (*that is*) ——	38
The Sum of all is ———————	76

which is the total value of the building and equal to the given Number.

Those who desire to see the demonstration of this Rule, let them read the 7*th*. Ch. of Mr. *Kerseys* Appendix to *Wingate*'s Arithmetick, *Petiscus* in the 5*th*. Book of his *Trigonometria*. Or Mr. *Oughtred* in his *Clavis Mathematica*.

Quest. 2. Three Persons, A, B, C, thus discoursed together concerning their Age; Quoth A I am 18 years of Age, quoth B I am as old as A and $\frac{1}{2}$ C; and quoth C, I am as old as you both, if your years were added together. Now I desire to know the Age of each Person? Answer, A is 18, B is 54, and C is 72 years of Age.

Quest. 3. A Father lying at the point of Death, left to his 3 Sons, *viz*. A, B, C, all his Estate in Money, and divided it as followeth, *viz*. to A he gave $\frac{1}{2}$ wanting 44 *l*. to B he gave $\frac{1}{3}$ and 14 *l*. over, and to C he gave the Remainder which was 82 *l*. less than the share of B, now I demand what was the

the Sum left, and each mans part? Answ. the Sum bequeathed was 588 *l.* whereof A had 250 *l.* B had 210 *l.* and C had 128 *l.*

Quest. 4. Two Persons, *viz.* A and B. had each in their hands a certain Number of Crowns, and A said to B, if you give me 1 of your Crowns I shall have 5 times as many as you, and said B to him again if you give me one of yours then we shall each of us have an equal Number; now I demand how many Crowns had each Person? Answer, A had 4 and B had 2 Crowns.

Quest. 5. What number is that unto which if I add $\frac{1}{4}$ of it self, and from the Sum subtract $\frac{1}{8}$ of it self the Remainder will be 210? *Answer* 192.

Many more questions may be added, but these well understood, will be sufficient (even for the meanest Capacity) for the Resolution of any other question pertinent to this Rule.

There may be an Objection made because we have not treated particularly upon interest and Rebate, but the operation of such Questions being more applicable to Decimals, are omitted, till we come to acquaint the Learner therewith.

Laus Deo Soli.

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